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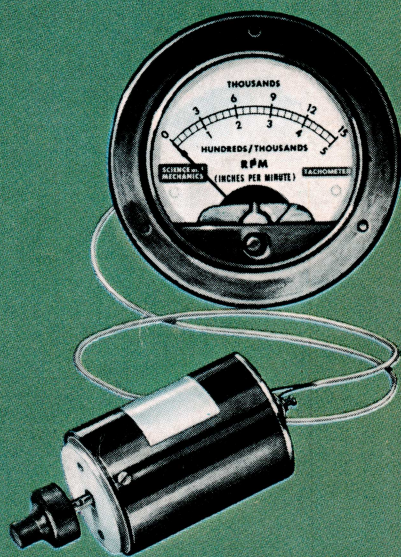
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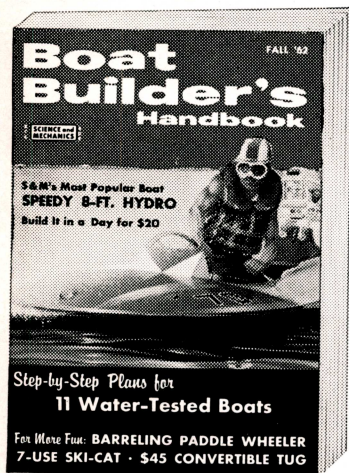


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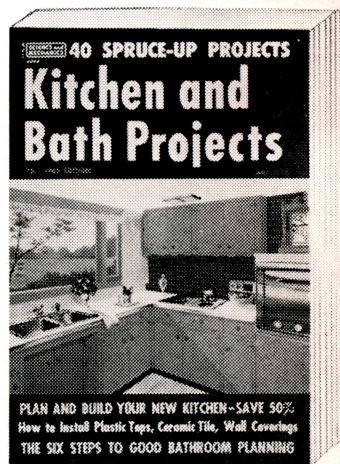
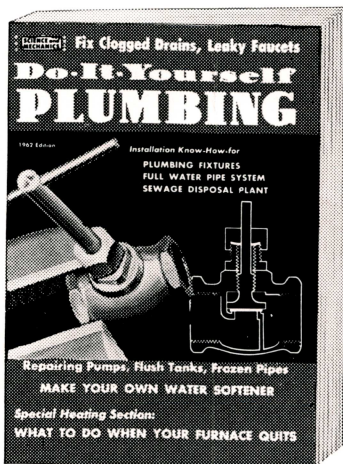
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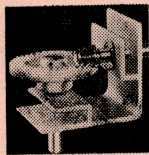


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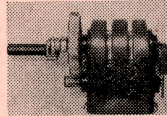
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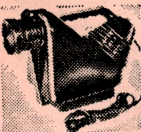
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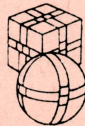


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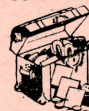
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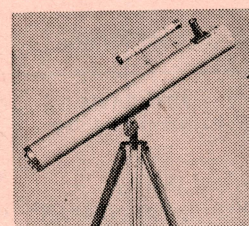
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1962 Edition

No. 606

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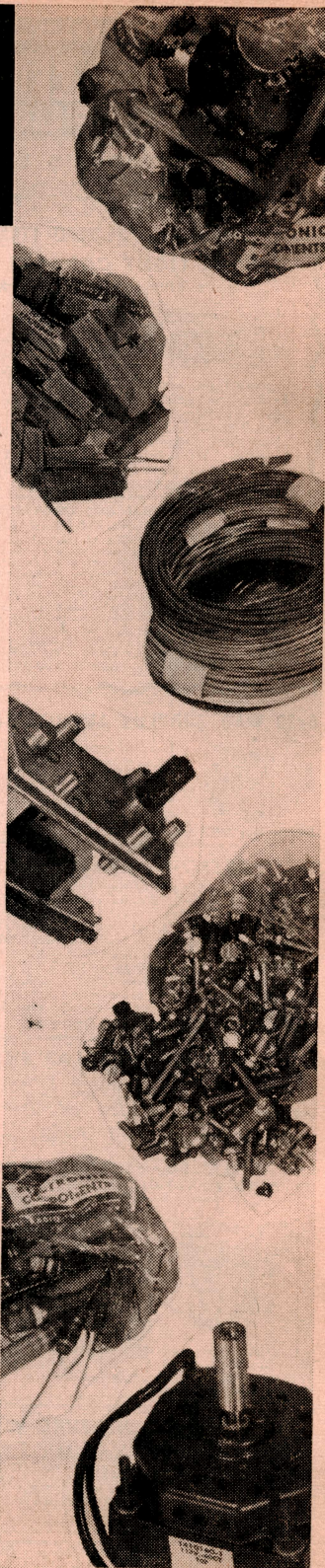
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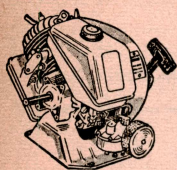
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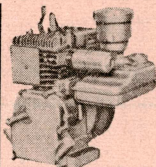
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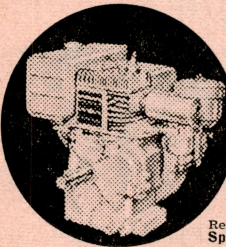


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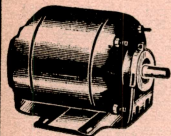
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You will learn the basic principles of radio. You will construct, study and work with RF and AF amplifiers and oscillators, detectors, rectifiers, test equipment. You will learn and practice code, using the Progressive Code Oscillator. You will learn and practice trouble-shooting, using the Progressive Signal Tracer, Progressive Signal Injector. Progressive Dynamic Radio & Electronics Tester, Square Wave Generator and the accompanying instructional material.

You will receive training for the Novice, Technician and General Classes of F.C.C. Radio Amateur Licenses. You will build Receiver, Transmitter, Square Wave Generator, Code Oscillator, Signal Tracer and Signal Injector circuits, and learn how to operate them. You will receive an excellent background for Television, Hi-Fi and Electronics.

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You do not need the slightest background in radio or science. Whether you are interested in Radio & Electronics because you want an interesting hobby, a well paying business or a job with a future, you will find the "Edu-Kit" a worth-while investment.

Many thousands of individuals of all

ages and backgrounds have successfully used the "Edu-Kit" in more than 79 countries of the world. The "Edu-Kit" has been carefully designed, step by step, so that you cannot make a mistake. The "Edu-Kit" allows you to teach yourself at your own rate. No instructor is necessary.

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You begin by examining the various radio parts of the "Edu-Kit." You then learn the function, theory and wiring of these parts. Then you build a simple radio. With this first set you will enjoy listening to regular broadcast stations, learn theory, practice testing and trouble-shooting. Then you build a more advanced radio, learn more advanced theory and techniques. Gradually, in a progressive manner, and at your own rate, you will find yourself constructing more advanced multi-tube radio circuits, and doing work like a professional Radio Technician.

Included in the "Edu-Kit" course are Receiver, Transmitter, Code Oscillator, Signal Tracer, Square Wave Generator and Signal Injector circuits. These are not unprofessional "breadboard" experiments, but genuine radio circuits, constructed by means of professional wiring and soldering on metal chassis, plus the new method of radio construction known as "Printed Circuitry." These circuits operate on your regular AC or DC house current.

THE "EDU-KIT" IS COMPLETE

You will receive all parts and instructions necessary to build several different radio and electronics circuits, each guaranteed to operate. Our Kits contain tubes, tube sockets, variable electrolytic capacitors, ceramic and paper dielectric condensers, resistors, tie strips, coils, hardware, tubing, punched metal chassis, Instruction Manuals, hook-up wire, solder, selenium rectifiers, volume controls and switches, etc.

In addition, you receive Printed Circuit materials, including Printed Circuit chassis, special tube sockets, hardware and instructions. You also receive a useful set of tools; a professional electric soldering iron, and a self-powered Dynamic Radio and Electronics Tester. The "Edu-Kit" also includes Code Instructions and the Progressive Code Oscillator. In addition to F.C.C.-type Questions and Answers for Radio Amateur License training. You will also receive lessons for servicing with the Progressive Signal Tester and the Progressive Signal Injector, a High Fidelity Guide and a Quiz Book. You receive Membership in the Radio-TV Club, Free Consultation Service, Certificate of Merit and Discount Privileges. You receive all parts, tools, instructions, etc. Everything is yours to keep.



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FROM OUR MAIL BAG

J. Statatis, of 25 Poplar Pl., Waterbury, Conn. writes: "I have repaired several sets for my friends, and made money. The 'Edu-Kit' paid for itself. I was ready to spend \$240 for a course, but I found your ad and sent for your Kit."

Ben Valerio, P. O. Box 21, Magna, Utah: "The Edu-Kits are wonderful. Here I am sending you the questions and also the answers for them. I have been in Radio for the last seven years, but like to work with Radio Kits, and like to build Radio Testing Equipment. I enjoyed every minute I worked with the different kits; the Signal Tracer works fine. Also like to let you know that I feel proud of becoming a member of your Radio-TV Club."

Robert L. Shuff, 1534 Monroe Ave., Huntington, W. Va. writes: "I would drop you a few lines to say that I received my Edu-Kit, and was really amazed that such a bargain can be had at such a low price. I have already started repairing radios and phonographs. My friends were really surprised to see me get into the swing of it so quickly. The Troubleshooting Tester that comes with the Kit is really swell, and finds the trouble, if there is any to be found."

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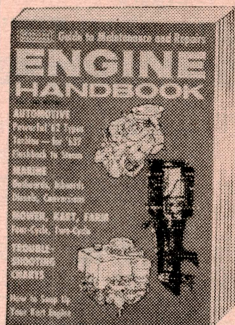
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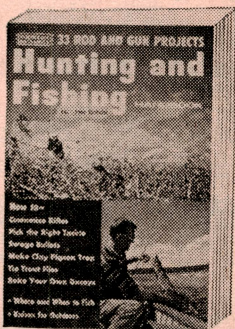
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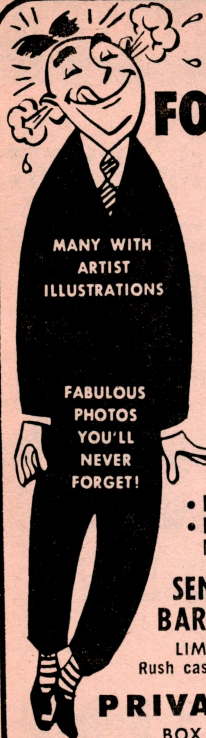
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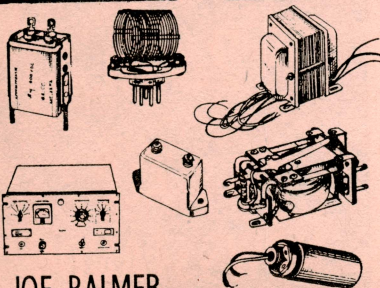
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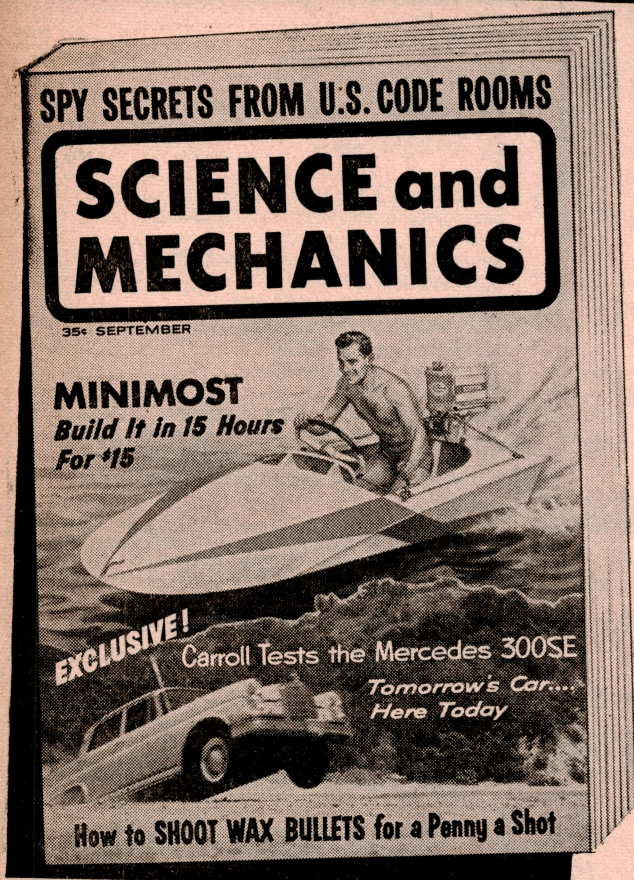
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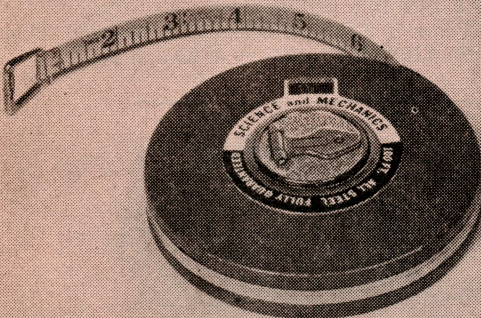
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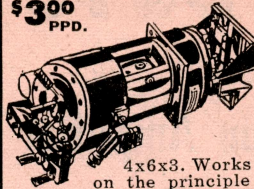
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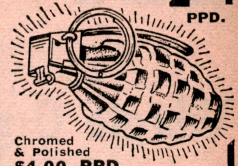
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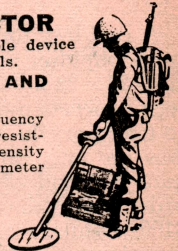
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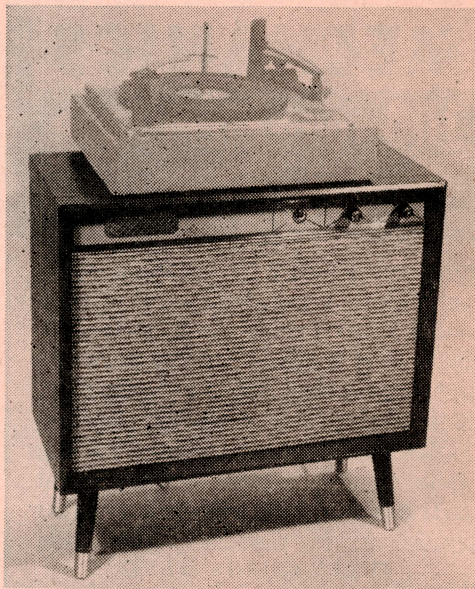
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The S&M Handbook staff ran a test with the phono cartridge of the turntable shown on top (not included) plugged directly into the amplifier input. Music was rich in tone. The unit can also be driven by contact mikes and pre-amps on musical instruments, or can be used with regular mikes and pre-amps



as a portable public address system.

Price is \$39.95 F.O.B. Mid America, Dept. SSP, 6101 N. Broadway, Chicago 26, Ill.

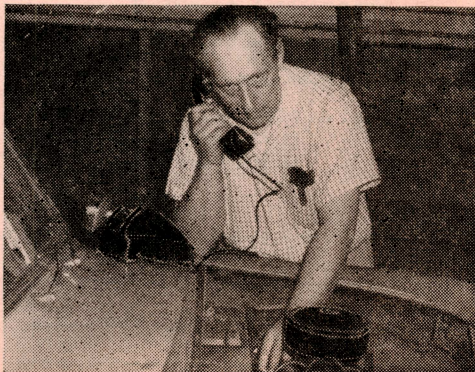
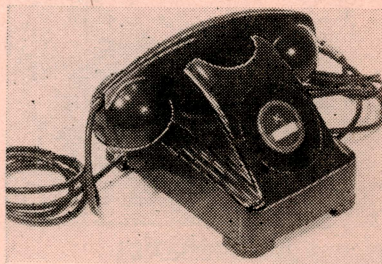
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These telephones have no dials—they were formerly used by a phone company that installed automatic dialing equipment. They are of the heavy-duty type and the price is so low that they can be used by the kids for house-to-house communication. The supplier offers a free catalog listing wire, batteries and many other items.

Phones priced at \$2.50 each or \$4.50 per pair plus postage by Olson Electronics, Inc., Dept. SSP, 260 S. Forge St., Akron, Ohio, or branch Olson stores. Order number is PH-76.



36 TOP VALUES FOR '62

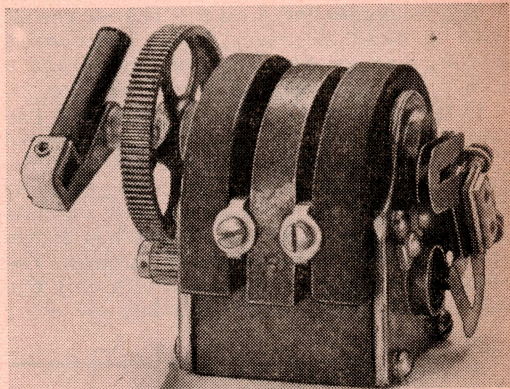
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Your Cost \$4.95

This brand-new, war surplus generator originally intended for use in a Signal Corps field telephone, opens up unlimited possibilities for experiment. Just by turning the crank you can generate up to 120 volts unloaded.

It can be used for classroom experiments to demonstrate uses of electricity, ring a bell, etc. Used in high impedance relays, it can charge the ground and bring up night crawlers for fishing bait. You can disassemble it to get two Alnico permanent magnets ($\frac{3}{8} \times \frac{7}{16} \times 2$ in.), gears, clutch.



The unit is $4\frac{1}{8}$ in. long and stands $3\frac{1}{8}$ in. high. Priced at \$4.95 ppd. by Edmund Scientific Co., 101 E. Gloucester Pike, Barrington, N. J.

$\frac{1}{2}$ -In. Chuck for $\frac{1}{4}$ -In. Drill

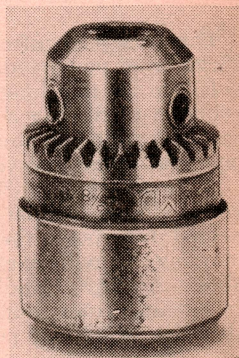
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Your Cost \$2.49

You can convert your $\frac{1}{4}$ -in. or $\frac{3}{8}$ -in. electric drill to $\frac{1}{2}$ -in. drill bit capacity with this heavy duty precision chuck, thus saving the cost of purchasing step-down $\frac{1}{4}$ -in. shank drills in the large sizes. The chuck will fit any electric drill having a $\frac{3}{8}$ -in. x 24-thread chuck

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Price is \$2.49 prepaid anywhere in the U. S. by Norbert Prehler & Sons, Dept. SSP, 1615 N. Milwaukee Ave., Chicago 47, Ill.

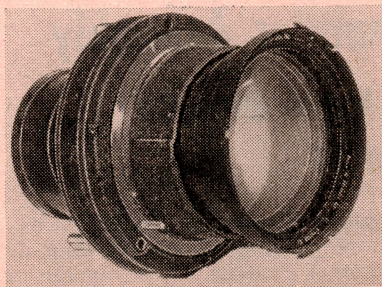


F/8 Telephoto Lens

Original Government Cost \$600

Your Cost \$39.95

Diaphragm stops ranging from f/8 to f/22 make this precision telephoto lens a perfect component for a telescope used in astronomical or telephoto-terrestrial photography. The five-element coated lens has a focal length of 36 in. Completely mounted with iris and shutter, in excellent condition.



Priced at \$39.95 F.O.B. C & H Sales Co., Dept. SSP, 2174 E. Colorado St., Pasadena 8, Calif. Made by Bell & Howell.

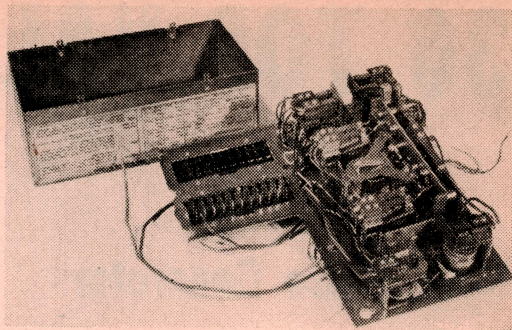
Multiple Relay Assembly

Original Cost \$35-\$40

Your Cost \$3.50

The relays mounted on this chassis can be used to build electronic games and scoring boards, also to operate small motors and a variety of remote control electric devices.

Catalogs show that the list price of just one of these relays is more than the cost of the complete package. You get five multiple-pole 24-volt dc relays plus one stepping (counter-type) relay which operates on plate voltages. One side of the stepper has 21 circuits; the other, 10 double-pole circuits. The chassis has a well-made cover with only one hole which can be used as a box for other



electronic projects. A 33-prong Jones plug with mating socket is worth almost \$4 alone.

These assemblies were taken out of new equipment and show little or no use. Priced at \$3.50 postpaid by American Science Center, Inc., Dept. SSP, 5700 Northwest Highway, Chicago 46, Ill. Ask for stock #8381.

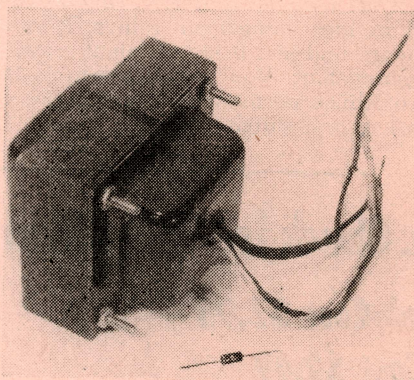
28-Volt Transformer

Original Value \$9

Your Cost \$3

This husky transformer is rated at 4 amps, 28 volts ac power when plugged into a 110-volt line. It is a long-awaited answer to the problem of finding a low-cost power supply for operating surplus motors, blowers, relays and other low voltage devices.

A small 1/2-amp 200 PIV (peak inverse volts) silicon rectifier is included. When connected in series to the transformer secondary winding, it will operate the relays shown above. An S&M Handbook staff test disclosed this transformer would deliver as much as 10 amps of 28-volt power for short periods.



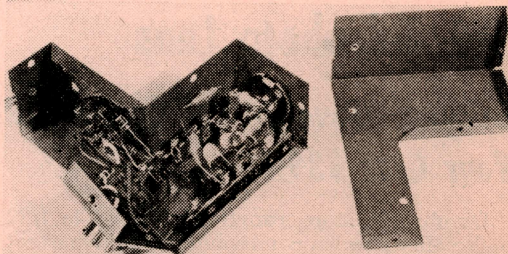
Available for \$3 postpaid from American Science Center, Dept. SSP, 5700 Northwest Highway, Chicago 46, Ill. Ask for stock #8359.

Pre-Amplifier Assembly

Original Value Over \$4

Your Cost \$1

This completely wired unit is ready to use as a microphone pre-amp, phono pre-amp, or with minor wiring changes can be converted to a CW ham transmitter or receiver. You will need an inexpensive 12AX7 tube which is not supplied. A 4 x 1 5/8 x 3 1/2-in. chassis includes 7 carbon resistors, 6 capacitors, 4 RF



chokes, a phono socket, terminal strip, 6-prong plug, and original circuit diagram. Priced at \$1 postpaid by Martin Electronics, Dept. SSP, Box 628, Evanston, Ill.

TV Test Instrument

Original Price \$274.50

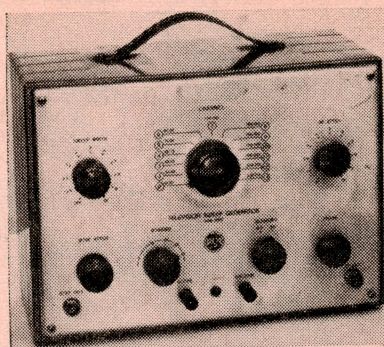
Your Cost \$33

RCA WR-59 series A, B, or C sweep generators provide test and alignment signals for TV turners, video, IF and RF channels 2 to 13. Sweep width is 10 mc, and tuning is continuous from 300 kc to 50 mc with a high output voltage, flat and free from spurious response.

Simple to operate, these units were used in factory production and are now offered to you at a fraction of original cost. Each is in good physical condition but, at this low price, sold "as is."

Priced at \$33 F.O.B. Mid America Co., 6101 N. Broadway, Dept. SSP, Chicago 26, Ill. A

BEST BUYS FOR '62



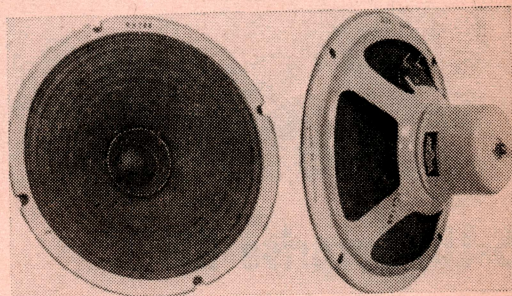
companion unit, the RCA WR-41A, a UHF television sweep generator for alignment at 420 to 920 mc, is also available at the same price.

Bargain from Britain

Original Value Over \$10

Your Cost \$3.49

Rated at 15 watts, this 8-in., 8-ohm full range speaker has a response of 40 to 15,000 cycles per second. The voice coil is double wound. There is a high frequency "whizzer" in the center and the main cone has a ground down "lo-flex" edge that improves compliance. Use it as a main source, or as an extension speaker in your bedroom, den, etc.



Priced at \$3.49 plus postage from Olson Electronics, Dept SSP, 260 S. Forge St., Akron 8, Ohio. Also available through Olson branch stores. Order number is S517.

5-Man Hexagonal Tent

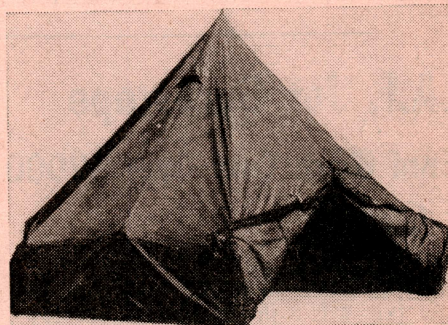
Original Govt. Cost \$145

Your Cost \$39.95

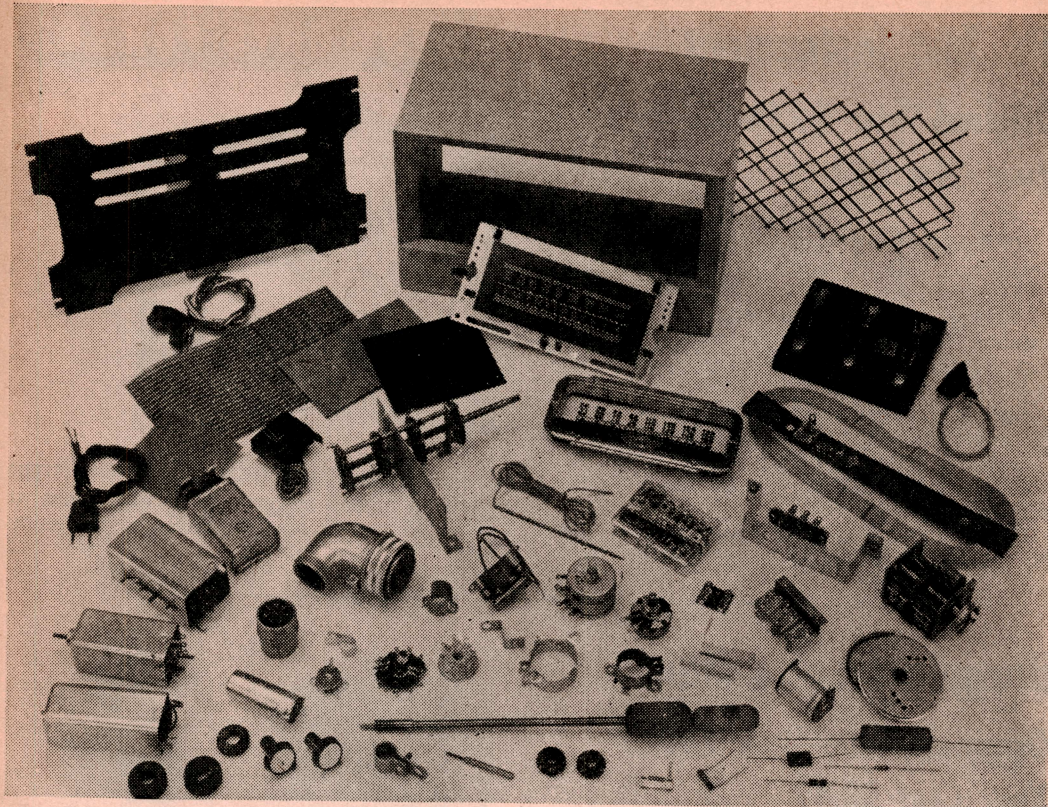
Here's a rugged tent which provides 147 sq. ft. of floor area with height of 8½ ft. at the center pole and 2 ft. at sidewalls. Made of 9-oz. Pima Arctic cloth, it is waterproof, mildew-proof, and fire-resistant.

Features include a zipper door closure, a sod cloth extending 8 in. inside and out, a 22-in. square window with cover flap, two sausage-type air vents in the top, and a removable cotton liner.

Available at \$39.95 for a used tent guaran-



teed to be in fine condition or at \$47.95 for a brand new tent, plus shipping charges, from P. & S. Sales, Dept. SSP, Box 4700, Tulsa, Okla.



5-Lb. Surprise Kit

Original Value Over \$12
Your Cost \$3.98

Shown here is a typical assortment of electronic parts and hardware packed in these

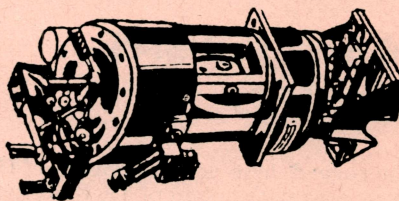
kits. The 5-lb. net weight package includes a complete radio cabinet, variable capacitor, band switch, coils, oil-filled capacitor, double-section pot, 6-ft. line cord, sockets, dials, knobs, grill cloth, fuse block, audio transformer, wire clamps, grommets, and dozens of useful small items, plus a kit of assorted nuts, bolts, and washers used in electronics.

Priced at \$3.98, postage prepaid anywhere in the U. S. from Lipman Sales, Dept SSP, 4749 N. Rockwell, Chicago 25, Ill.

U.S.A.F. Jet Gyroscope

Original Govt. Cost Over \$2000
Your Cost \$3

A simple wind principle activates the wheel of this 4x6x3 precision jet gyroscope, but it can also be operated by an air compressor or an ordinary dry cell. It's considered a top value for any home shop experimenter just for the mass of mechanical and optical parts it provides. Original cost of the unit, made by the Sperry Gyroscope Co. for the Air Force, is said to have exceeded \$2000.



Wrapped in waterproof foil and oilcloth-lined paper, the unit is shipped in its original government-packed carton which alone cost more than today's total price for this surplus bargain.

Priced at \$3 postpaid by Kaufman Surplus & Arms, Dept. SSP, 623 Broadway, New York 12, N. Y.

Black Light Film Printer

Original Cost \$85

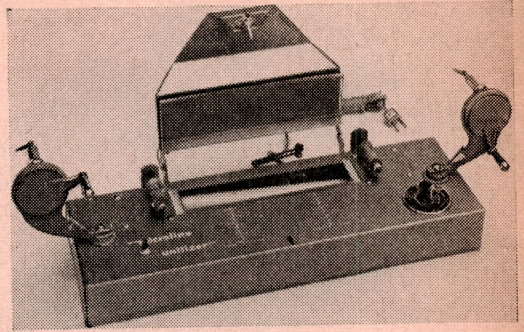
Your Cost \$18.50

Make contact prints of film transparencies in daylight through the magic of black light. An unusually good buy for professional photographers, serious amateurs or those who would like to experiment with the fascinating properties of black light.

This printer is versatile. It can readily be adapted to such uses as film editing or black lighting various materials for study or fun. It comes complete with special film viewing light, black light lamps, 0-60-second automatic cutoff timer, geared-up spool winders for fast film-winding, on-off switch line cord and full instructions. Spools handle 16mm and 35mm film.

Unit is of all-metal construction with over-

BEST BUYS FOR '62



all dimensions about 25¼ in. long, 7¾ in. wide, 6¾ in. deep. Special print paper is not included but is easily available locally.

Price \$18.50 postpaid by Edmund Scientific Co., Dept. SSP, 101 E. Gloucester Pike, Barrington, N J.

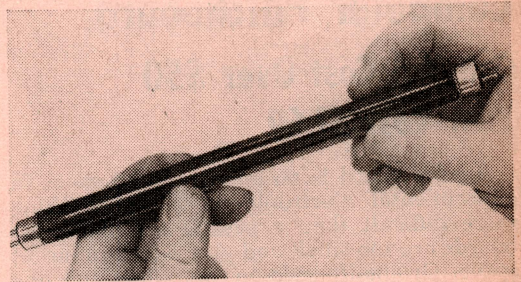
6-Watt Black Light Tube

Original Price \$3.25

Your Cost \$2

This 9-in. long-wave tube, now offered at a new low price, has a built-in filter cutting out about 80% of visible light, so that all you have to do for black light experiments is use it in a fluorescent-type fixture.

Helpful in study of medicine, minerology, sanitation, advertising displays, and various



other fields. Priced at \$2 postpaid by Edmund Scientific Co., 101 E. Gloucester Pike, Barrington, N J.

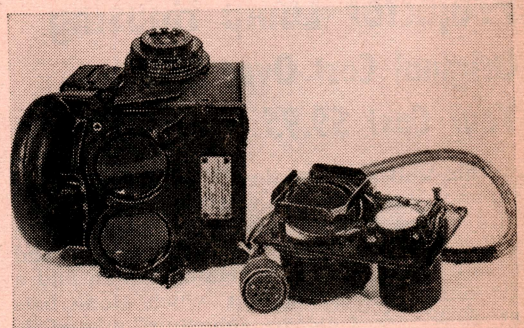
Gadgeteer's Delight

Original Govt. Cost Over \$200

Your Cost \$2.95

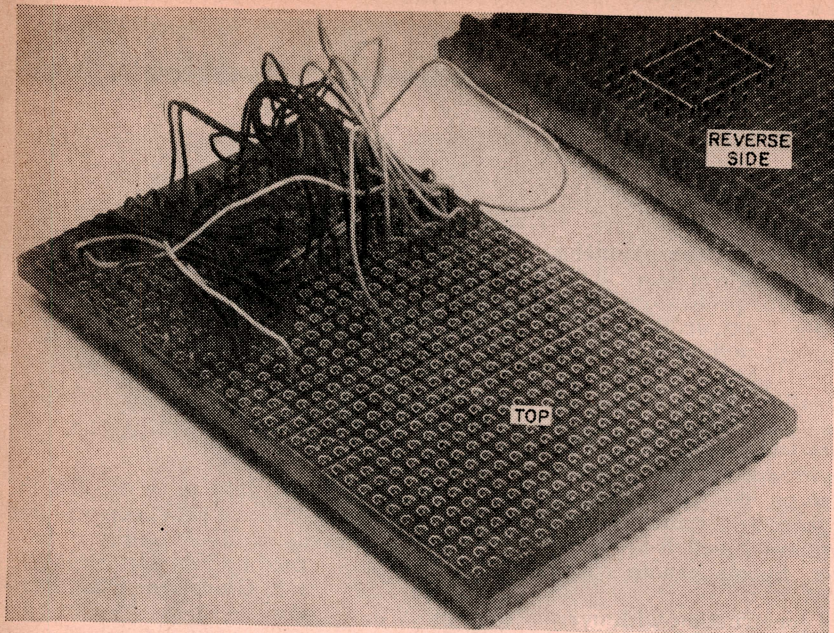
The S&M Handbook staff took this K-14 gun sight apart and found a fascinating array of very unusual optical equipment. Assembly at right consists of two Autosyn motors which ran very smoothly at 28 volts dc. The mirror is so delicately balanced on gimbals that it will hold its angle by gyroscopic action when you rock the assembly about in your hands.

Also included are a ¼-in. reflecting mirror, worm gear adjusting shutter and an illu-



minating unit with two light bulbs and sockets.

Priced at \$2.95 plus shipping (10 lbs.) from Fair Radio Sales Co., Dept. SSP, 2133 Elida Rd., Box 1105, Lima, Ohio.



Computer Patchboard

Original Cost Over \$50

Your Cost \$1.69

A patchboard is an amazing time saver in experimental electronic work on anything more difficult than a crystal set, but most boards are too small and you soon run out of space. Originally used on computers, this one has 680 jacks arranged on $\frac{1}{4}$ -in. centers in 34 rows of 20 each on a tough $\frac{3}{8} \times 6 \times 10\frac{1}{4}$ -in. board. The jacks take standard pin plugs and

kits of 20 assorted patch cords with plugs on each end available at 99¢.

To use the board, it is wise to color-stripe each row. You can solder common bus connections across the backs of some of the jacks to make any number of quick connections to a desired place in your circuit. At this very low price, you can afford to use these panels as breadboards, wiring sockets, coils, etc., directly to the board.

Priced at \$1.69 plus shipping from Olson Electronics Inc., Dept. SSP, 260 S. Forge St., Akron, Ohio, or Olson branch stores. Order stock #PL 88. Three boards are priced at \$4.50, or two boards (#PL 90) with 40 patch cords at \$4.41.

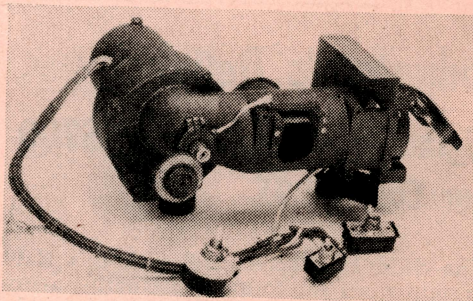
Projector Lamp Housing

Original Cost Over \$75

Your Cost \$9.95

This unit is from the U. S. government's film scoring viewer on which aircraft films of hits scored were analyzed. It consists of a 110-volt, 60-cycle squirrel cage blower and motor, on-off switch, reversing switch and a 100-ohm *Ohmite* rheostat which alone lists at \$6.22. A concave reflecting mirror is mounted on a removable screw-in plug in the lamp housing. A geared pulley works off a worm gear mounted on the blower motor shaft.

Besides blower cooling with this unit, you



can use it to build a projector around the housing or use its gear train to power small units.

Priced at \$9.95 postpaid by American Science Center, Inc., Dept. SSP, 5700 Northwest Hwy., Chicago 46, Ill. Stock #83791.

Mobile Audio Amplifier

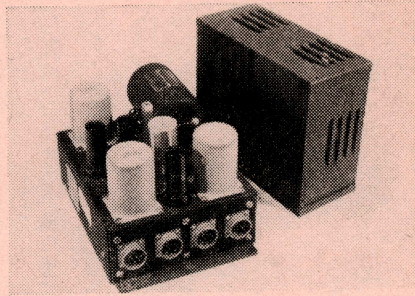
Original Cost Over \$45

Your Cost \$2.95

Originally built by Magnavox for Navy use in small boats and vehicles, this TCS type interphone amplifier makes a fine mobile public address system for your car or boat. The gear is very rugged, and was used to boost a receiver signal to feed a number of intercom lines. It employs two 12A6 audio tubes in push-pull, requires 12-volt dc battery power and draws 1 amp. Plate voltage is supplied by a 250-volt dynamotor (sold as an extra) which mounts on the chassis.

With schematic and manual, the unit is

BEST BUYS FOR '62



priced at \$2.95 F.O.B. Fair Radio Sales Co., Dept SSP, Box 1105, Lima, Ohio. Dynamotor and three 12A6 tubes are \$6.96.

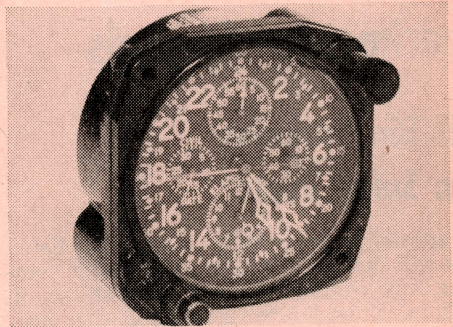
8-Day Elapsed-Time Clock

Original Government Cost \$185

Your Cost \$39.95

Here's a whole time-control center in one precision instrument. It's a 24-hour clock; a stop watch giving you elapsed time in seconds, minutes, and hours; a calendar giving you the date of the month. Use it for ham radio, aboard ship or aircraft, for sports car rallies and races, etc.

Manufactured by Elgin Watch Co. to exacting military specifications, this unit is jeweled, has sweep second hand, black face and



case, 3 1/8-in. mounting, and remains accurate under severe conditions.

Priced at \$39.95 postpaid by C & H Sales Co., Dept SSP, 2174 E. Colorado St., Pasadena 8, Calif.

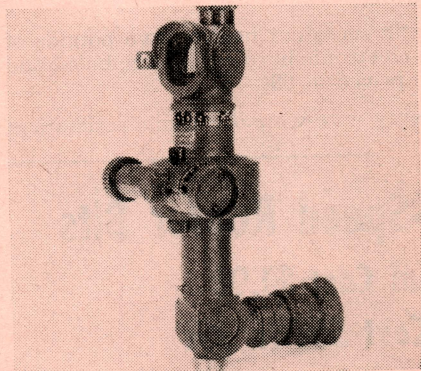
Panoramic Telescope

Original Government Cost \$350

Your Cost \$15

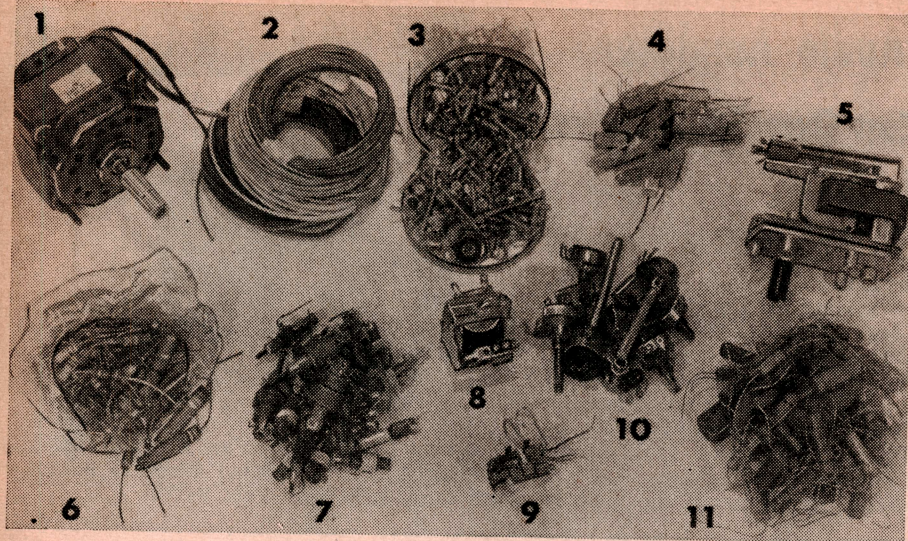
Valuable optical components go into this U. S. Army M-12 six-power panoramic telescope. Among them are an achromatic objective lens with 4 1/4-in. diameter and focal length of 4 1/4 in.; Amici roof prism 34mm long and with face width of 20mm; eyepiece with 1-in. focal length and 7/8-in. clear aperture, and 5mm exit pupil.

The unit is 9 3/4 in. high, has grid type reticle, objective right angle prism with 1 5/16-in. clear aperture and offers a field of view about



7° or 36 ft. in 100 yds.

Priced at \$15 postpaid by Edmund Scientific Co., 101 E. Gloucester Pike, Barrington, N. J.



Experimenter Specials

11 Big Bargains In Small Parts

By special arrangement, the supplier listed below will deliver a minimum \$3 order comprising any combination of items shown in the photo. From left to right at top, they are:

1. An Alliance four-pole, shaded pole induction motor. New, it was designed for a tape recorder, but can be used for quality record player, fans, etc. It will operate in either direction at 1550 rpm and is priced at \$3.49.

2. An assortment of six rolls of tinned copper wire, priced at 59¢.

3. Plastic container holding two pounds of assorted electronic hardware, nuts, bolts, and washers, priced at 98¢.

4. Twenty wire-wound ceramic resistors of

the latest type for TV, radio, computers, and amplifier, for \$1.49.

5. A 22.8 rpm continuous-duty, 115-volt, 60-cycle Molon motor. Ideal for remote controls, displays, turntables, etc., it has an instant-stop clutch and is priced at \$2.29.

6. A \$1.98 kit containing 100 ½-, 1-, and 2-watt carbon resistors in popular radio and television values, cataloging at more than \$5.

7. Group of 25 assorted slug-tuned radio and television coils, ideal for experimental circuits. All new, priced at 59¢.

8. Latching-type plate circuit relay for 98¢.

9. Sensitive Sigma plate circuit relay, also for 98¢.

10. Volume control kit, including seven controls without switch and three controls with switch in a variety of changes. A buy for the serviceman at \$1.49.

11. Assortment of new tubular capacitors in popular radio and TV values. Worth over \$5 in any catalog. Priced at 98¢.

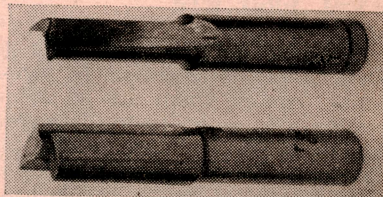
Any combination of the above items totaling \$3 or more (postage extra) available from Mid-America, Dept. SSP, 6101 N. Broadway, Chicago 26, Ill.

High-Speed Router Bits

Original Cost \$1.98

Your Cost 50¢ to 75¢

These two-fluted router bits are recommended for use in soft metals such as brass and aluminum, plastics or wood. Two sizes available: ⅝ in. and ¾ in. The ⅝-in. size,



regularly priced at \$1.98, is available at 50¢, while the ¾-in. bit is offered for 75¢ F.O.B. Wholesale Tool Co., Inc., Dept. SSP, 12800 E. Nine Mile Rd., Warren, Mich.

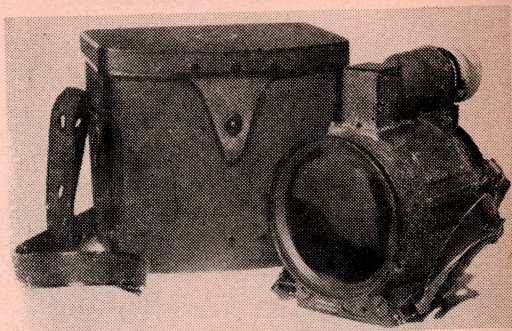
Snooperscope

Original Government Cost \$300
Your Cost \$19.95

You can see in complete darkness with this precision snooperscope, more formally known as a type B metascope infra-red receiver. Elaborate optical system with many coated lenses makes it ideal for hobbyists. Unit operates on two pen cell batteries; there is nothing to wear out. Simply hold it to your eye as you would a telescope. Unit weighs only 4½ lbs., is excellent for surveillance, security, animal-watching, etc. You'll need an infra-red (invisible) light source. The supplier has a 6-volt, high-intensity sealed-beam flood lantern that's water-tight and portable.

Price of Snooperscope \$19.95 plus shipping

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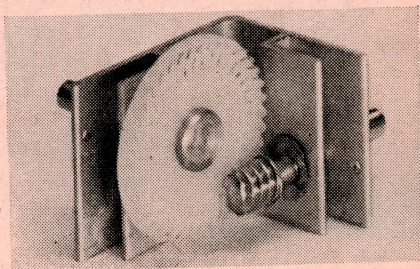
(8 lbs.) from C & H Sales Co., Dept. SSP, 2176 E. Colorado St., Pasadena 8, Calif. Price of sealed-beam flood lantern \$14.95 (23 lbs.). Waterproof carrying case for the 'scope \$3. All prices are F.O.B. Pasadena.

Gear Reduction Unit

Original Cost \$9
Your Cost \$5

This inexpensive gear tuner assembly provides completely backlash-free tuning. It can be used for a manual drive on a small telescope, or as a hand-operated input to any mechanical equipment. It is excellent for magnitron tuners, variable condensers, potentiometers, coils and other devices requiring fine adjustment.

Gear assembly has a 19.5:1 ratio and capacity of 20 in./lbs. All materials are non-corrosive, with gear of molded nylon, pinion



of cadmium-plated brass, and bracket of anodized aluminum.

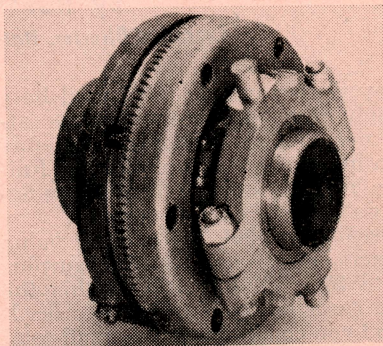
Unit is completely assembled, less knob, has center distance of .548 in., gear diameter of 1.687 in., and pinion diameter of .418 in.

Priced at \$5 postpaid by Edmund Scientific Co., Dept. SSP, 101 E. Gloucester Pike, Barrington, N. J.

15 HP Friction Clutch

Original Cost \$49
Your Cost \$8.95

Motor side of this clutch has a 1⅞-in. bored hub with keyway; power side, a 1⅞ x 10-in. spline-bored hub. Either hub can be adapted for your installation by bushing or boring. The clutch has a 4-in. diameter, is fully adjustable, and manually operated. Complete with brass yoke, the unit weighs 8½ lbs. and can be used for go-carts, pumps, saws, tractors, small cars, and scooters.



Priced at \$8.95 F.O.B. Wholesale Tool Co., Inc., Dept. SSP, 12800 E. Nine Mile Rd., Warren, Mich.



Casters, wheels, fans, cable, electronic parts, etc., make up this typical government surplus display by wholesaler at trade show for retailers and mail order firms.

Government Surplus Still Big Business

By HORST H. BACKER

Executive Director, National Surplus Dealers Assn.

FOR many years to come, there will be a vast supply of government surplus to satisfy the needs of the hobbyist or enable him to turn his hobby into a profitable, full- or part-time business venture. Read these figures and you'll see what we mean:

During fiscal year 1961, the original value of government materials declared surplus amounted to \$7.5 billion. Add to this the value of the items left over from the preceding year, and you come up with a grand total of \$8.4 billion in surplus.

New Disposal Methods. The federal government has a responsibility to dispose of this staggering stockpile in a manner serving

the best interests of the taxpayers and recovering the greatest possible amount of money. Toward this end, Uncle Sam made some drastic changes in disposal methods within the past year.

After extensive study by various agencies, the Secretary of Defense established a "Defense Supply Agency" directly under his control. Its charter states, in part, that this agency shall be responsible for administration and supervision of the Defense Surplus Personal Property Disposal Program. Thus, a buyer can now contact a single federal group to be placed on a prospective bidder's list. This agency is the Defense Surplus Bid-

ders Control Office, located at 2100 N. New Braunfels Ave., San Antonio 8, Tex.

Sales conducted by the new agency have introduced new innovations such as "closed circuit television or telephone sales, by auction method." The old standard sales are also being conducted, except that individual sales appear to have a larger diversification of merchandise and are much better organized. The retail sales method, still used, is now generally limited to small quantities of property having direct appeal to consumer purchasers. They usually include such items as blankets, hand tools, footwear, and furniture.

What the Buyer Faces. If you are a hobbyist, it's still a big question determining whether to buy government surplus direct or from retail and mail order firms that are easily available. To answer this, look over these facts; then you be the judge.

Last January, the Defense Supply Agency conducted a nationwide two-day auction sale in a major Chicago hotel. The sale was not televised nor on a phone hookup. To buy, or try to buy, you had to be there in person. And, to show your sincere interest as a prospective buyer, you had to come up with a \$200 deposit with the understanding that it would be immediately refundable if you did not make a purchase.

The auction covering approximately \$15 million worth of assorted items, was widely advertised. Buyers from 40 states and representatives of so-called commercial buyers from such distant places as France, Holland, Italy, and Mexico, were among the 1228 individuals in attendance. Of this total, 614 prospective bidders registered by submitting their \$200 deposit, but only 215 of them were actually successful in buying any of the items offered.

When you realize that the total value of items offered was around \$15 million, how



George Beam, government auctioneer, in action during nation-wide public auction sale held this year in Chicago for Rock Island Arsenal under auspices of Defense Supply Agency. Over 600 items were presented on color slides to bidders at rate of nearly one per minute.

many hobby buyers do you think were among the successful bidders?

Locating Specific Surplus. In our article, "Pros and Cons of Buying Government Surplus," published last year in S&M's "Surplus Projects" (Handbook #583), we offered assistance in locating certain items. There were approximately 1600 inquiries by mail, 250 by phone, and 100 through individuals visiting our office. Mostly they wanted to know where to buy Jeeps, electronic parts, photographic equipment, and how to get parts manuals and replacement parts for government surplus items—some of World War I vintage.

Government to Offer \$25 Million Surplus At Public Auction in Chicago Oct. 30-31

Recently-declared government surplus with an acquisition value of about \$25 million will be offered at public auction in Chicago this fall by the Defense Surplus Sales Office.

The sale will be held Oct. 30-31 at the Hotel Sheraton-Chicago concurrently with the second annual Industrial and Government Surplus Trade Exposition. The latter show, specializing in hard goods surplus for retail and mail order trades, will run from Oct. 28 through Nov. 1 under direction of the National Surplus Dealers Assn.

It is understood that the government auction will be patterned after a similar

sale of surplus valued at \$15 million which was held in Chicago last January. At that time, prospective buyers were required to deposit \$200 upon registration, returnable immediately if no purchases were made. Over 600 units were offered to buyers whose bids were made on the strength of catalog descriptions and color-slide photos.

Catalogs for the October sale are expected to be available about Sept. 30. At that time, NSDA reports it will forward all postcard requests for copies received at its office, 79 W. Monroe St., Chicago 3, Ill., to the Defense Surplus Sales Office mailing center.



Representatives of U. S. Department of Defense and National Surplus Dealers Assn. meeting at the conference table to work out better methods of disposing of government surplus.

Our office receives a copy of every government-issued sales offering and we have carefully studied them as a result of these inquiries, but we have yet to find any electronic, photographic, or similar parts offered in the small quantities sought. Jeeps are offered rarely but when there is such a sale, in 99% of the offerings you will find the units are being sold for salvage. It would cost you, as an individual, more to get such a Jeep in running order, if you could find the spare parts, than the price of a new or good used model bought from your local car dealer.

This is because most items manufactured for the government were made to its specifications, which are not standard about 85% of the time. That means you may have trouble buying spare or replacement parts. By and large, however, you will be able to buy such parts from stores and mail order firms which specialize in surplus.

Case for the Dealers. While the federal government has made great strides in making it easier to buy surplus goods direct, you must remember that such buying is arranged under a sales contract with rigid recourse limitations. On the other hand, you have normal recourse when you buy from a commercial dealer.

Firms in the retail and, for that matter,

wholesale surplus business today are well established and remain in business because the public continues to buy from them. Firms that were—and there were very few of them—strictly “fast-buck” promoters have fallen by the wayside. After all, no firm can stay in business very long if it is not operating honestly.

In closing, we repeat that government surplus can afford you many hours of pleasure as a hobby or source of additional income. So by all means buy direct from the government when you can but always remember that you can usually buy just what you need for less from the business firm that has taken the gamble and stocked the very surplus items you are looking for.

You'll find large numbers of these firms listed in the Where-to-Buy-It Directory of this handbook. Look for still other listings in the classified pages of your telephone book.

EDITOR'S NOTE: Readers who have difficulty locating an item are invited by the author to get in touch with him at National Surplus Dealers Assn., 79 W. Monroe St., Chicago 3, Ill., for possible surplus sources. However, he warns, “please remember that we are not technical experts nor familiar with all of the millions of different parts and items of government surplus.”

POWERCYCLE

with detachable carrying cart

By JOE McBRIDE

THIS animated short snorter will barrel you along at 35 mph. When the fun's over, you can tuck it into your car or boat with ease. Lifting is no problem; it weighs only 55 pounds.

When equipped with the detachable side cart (Fig. 2), the scooter becomes a practical package carrier for shopping or special delivery service, or a tool carrier for farm and field servicemen. With some alteration in size and shape the same method of building and attaching this cart can be applied to adding a side cart to any power scooter.

Although we used a 2-stroke cycle Clinton A400 engine, almost any 2- or 4-stroke cycle engine having a maximum of $2\frac{1}{2}$ hp could be used. The lightweight, vertical cylinder, horizontal shaft, 4-cycle engines, such as the Clinton A2100 or Briggs and Stratton 6B or 6B-5, offer some advantages over the 2-cycles in that they can be throttled down to run smoothly at slow speeds, are easier to start and do not require mixing of oil with the gas. Do not, however, use any of the heavy cast iron engines since their additional weight located off center on this small powercycle tend to make steering difficult and erratic.

So then, you'll have transportation for yourself (Fig. 1) plus load carrying capacity with this little side-cart equipped powercycle, and the cart (Fig. 2) can be detached in the time it takes you to loosen three bolts.

Since the shape and size of the frame members must be determined by the size of other matching parts, have on hand all of the parts given in the Materials List before starting actual construction.

Making the Cycle Frame. Begin by hacksaw-



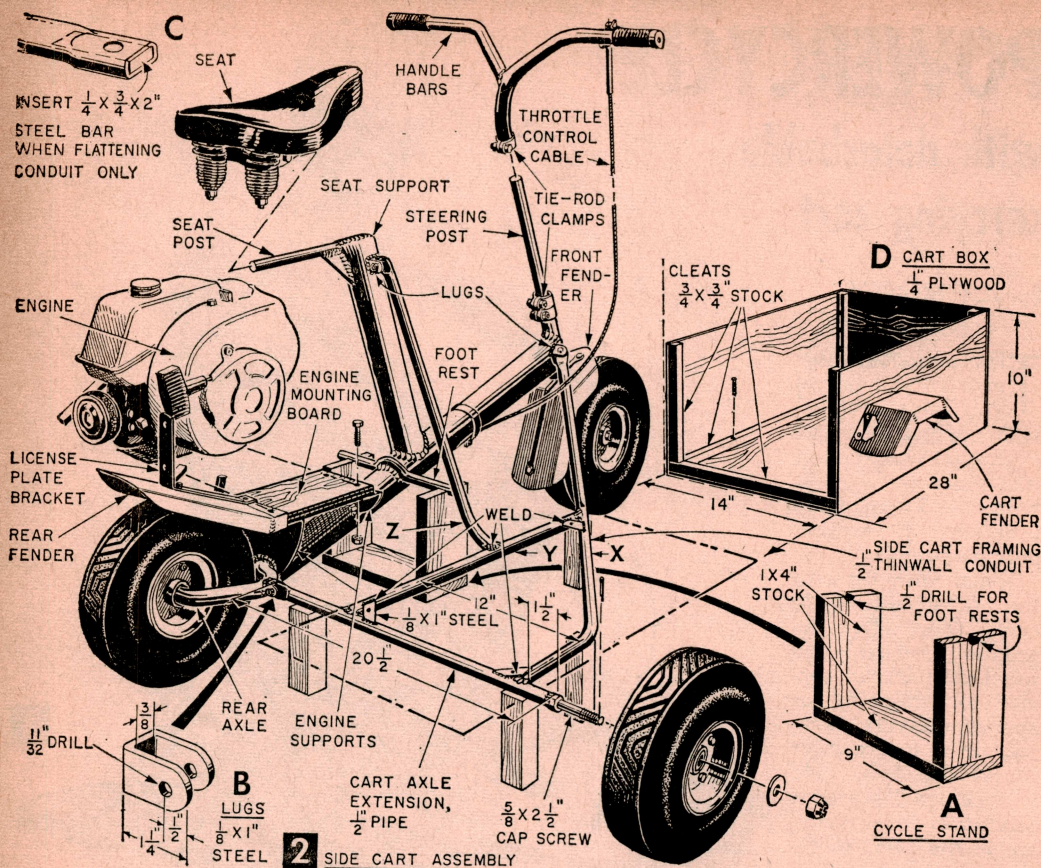
Speeding along on the powercycle at 35 miles per hour, side cart not attached.

ing the Chevrolet propellor shaft to length as given in Fig. 5A. Chuck, or tack-weld a block on the tube end of the shaft for a center, and mount the prop shaft in a metal-turning lathe. The lathe will have to have a 3-ft. between-centers capacity.

If you do not have a lathe to do the work yourself, it will pay you to have the front fork (Fig. 6A) ready for machining, too, so that you can have all of the lathe work needed to build this cycle done at one time.

The front fork is made from a Mercury sway bar which is heat-treated spring steel and may be a little too hard for sawing and machining without first annealing. To anneal the bar, heat it to a dull red and allow it to cool slowly. You can do this with an acetylene torch or, better still, if there is an automobile spring shop or heat treating firm in your area, have them heat the entire bar in their furnace.

After machining the front and rear axles, assemble the wheels on them to make certain everything fits well. Then lay out and cut the two bending templates from sheet



metal as in Fig. 5. When bending the rear axle and front fork, grip the stock in a vise and use an acetylene torch to heat just those areas of the stock that you are bending. Heat to a bright red and do not hold the torch too long or too close at one spot. If the metal starts to sparkle, it indicates it is burning and is too hot. Do not quench with water to cool but allow to cool slowly to room temperature.

An 18-in. length of $\frac{1}{2}$ -in. black iron pipe with one end drilled out to $\frac{5}{8}$ in. (so that it can be slipped over the ends turned down for the axles) will protect the machined surfaces and give you the leverage needed for bending. Use the bending templates to check the amount and angle of the bends occasionally. Final accuracy of bend must be checked by mounting the wheels with tires. Wheel centers must be in line with centerlines of shafts and have clearance for tires. Allow space for installation of fender on front fork. Note that the front fork has a secondary bend, other than those shown on the template, of 2 in. forward for wheel caster effect. The rear axle arm is bent 15° from centerline of tube as in frame assembly drawing Fig. 5.

Cut the fork bushing (Fig. 6B) from $\frac{1}{2}$ -in. pipe and run a $\frac{5}{8}$ -in. drill through it to clean

up the inside so that the bushing will slide on the turned portion of the front fork.

Then flatten the end of the frame tube (A), and file the top and bottom edges of the tube half-round to take the fork bushing at 85° as in the frame assembly drawing Fig. 5. After welding the bushing to the frame, again drill it out because the heat of welding may have distorted it somewhat.

Use the cut-off piece of prop shaft tubing for the seat support (Fig. 5B). Grind or file the end of the support to fit tightly against the frame tube. This operation, which is commonly called "fishmouthing" the end of a tube, will make welding a lot easier because you will not have gaps to fill. If you are going to use a Clinton engine as we did, weld the seat support to frame A, locating its center 12 in. from the rear end of the frame tube as in the frame assembly, Fig. 5. If you are going to use a Briggs and Stratton aluminum vertical cylinder engine, locate the seat support 10 in. from the rear end of the frame tube. Then heat and bend the foot rest (C in Fig. 6), and weld it to the frame tube right in back of the seat support.

To determine the angle at which the remaining parts are welded to the frame, tem-



Small passengers only; and give them a cautious ride.

porarily assemble the front and rear wheels on their axles. Then slide the ball thrust bearing on the front fork and insert the fork through the fork bushing on the frame. Place one tie-rod clamp at the top of the fork bushing over the saw slot and another clamp above it on front fork shaft (Fig. 4).

To support the cycle and keep it in an upright position while you work on it, make up a wooden stand from scrap 1 x 4-in. stock as in Fig. 2A. Place the stand under the foot rest, and weld the seat post to the top of the seat support so that it is parallel with the floor. Hacksaw the gusset from a piece of $\frac{1}{8}$ x 1-in. strip steel and weld it to the corner where the seat post joins the seat support as in the frame assembly Fig. 5. If you are using the vertical cylinder engine with the seat support located closer to the rear, you will not need the gusset and will need a seat post only 5 in. long.

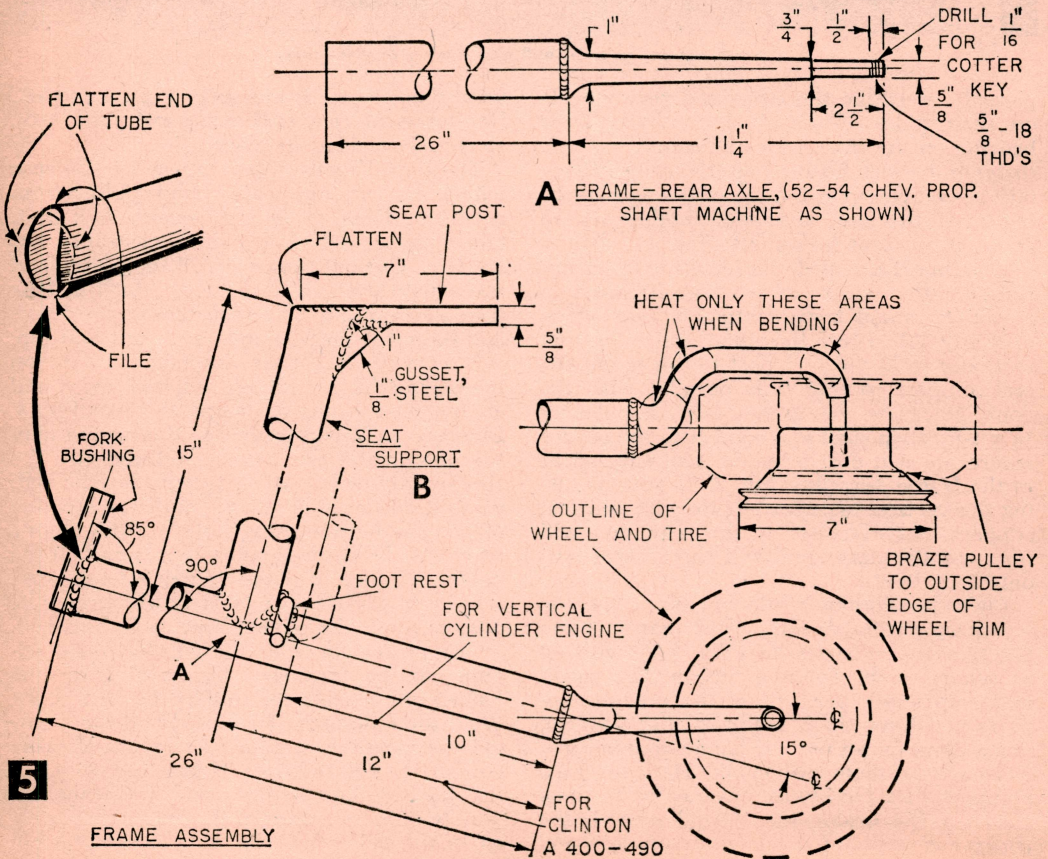
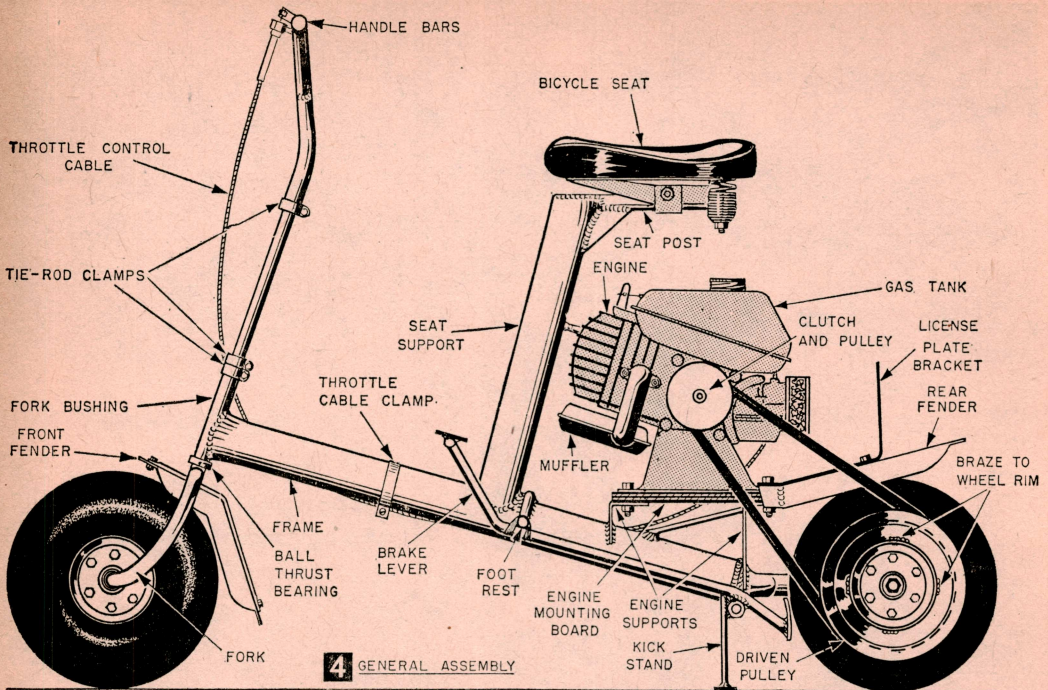
Engine Installation. While you are at the auto wrecking yards have the yard man cut you the two engine supports (Fig. 7A) with an acetylene torch. To save time at the yards, make up paper patterns of the engine supports and have them ready so that you can place them on an old car frame channel and draw around them with chalk. Have the yard man cut off a 2 x $2\frac{1}{2}$ -in. piece of $\frac{1}{8}$ -in. thick steel for the brake, too. Grind smooth the rough-cut edges of the engine supports and

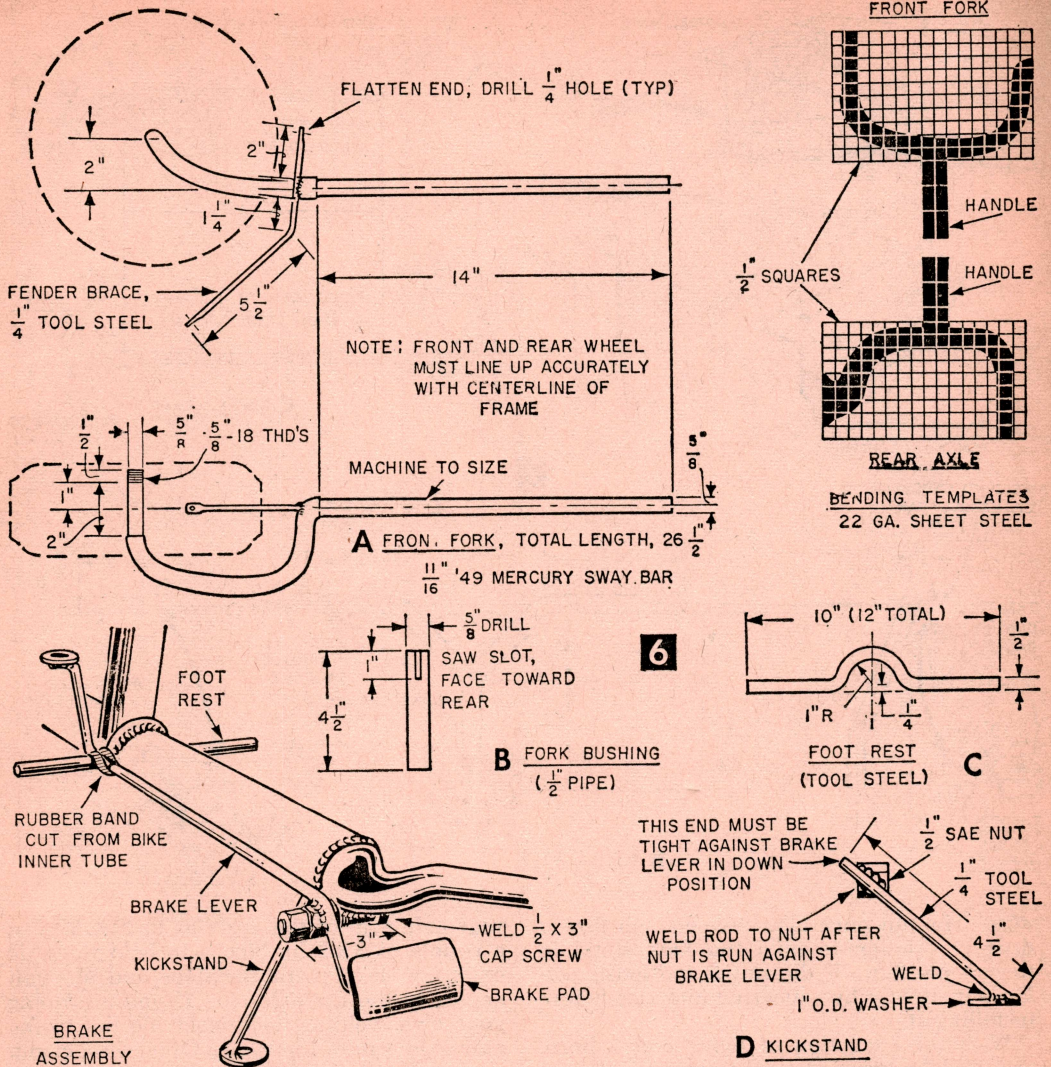
weld them to the frame as in Figs. 4 and 7A. Reinforce the rear engine support with $\frac{1}{4}$ -in. steel rods welded in place.

The best V-belt pulley to use for the rear wheel is a 7-in. dia. water pump pulley from a Chevy, Olds, or Buick because it has an offset center which provides clearance for the tire. Cut out the center of the pulley and braze it to the rim of the rear wheel at four places as in Fig. 4. Then reassemble the wheel and mount it on rear axle with nut and pin.

Now, with a V-Plex automatic clutch on the engine drive shaft, place the plywood and engine on the engine supports as in Fig. 4. Line up the V-belt pulley on the engine with the one on the rear wheel and measure the size V-belt needed. After purchasing the belt, place it on the pulleys and mark the location of the engine mounting holes on the engine supports. Drill these holes $\frac{3}{8}$ -in. and bolt the engine in place. To take up belt stretch later, a piece of plywood $\frac{1}{4}$ to $\frac{3}{4}$ -in. thick may be placed under the engine base as in Fig. 4.

The performance of the Clinton A400 engine can be improved by opening up the baffle plates inside the muffler (A in Fig. 9). Weld the exhaust holes closed and for a new exhaust opening, weld a 3-in. length of $\frac{3}{4}$ -in. conduit to the muffler. If you are going to use the side car on the cycle, weld another 3-in. length of conduit to the exhaust opening as in the side view Fig. 9 to direct the hot





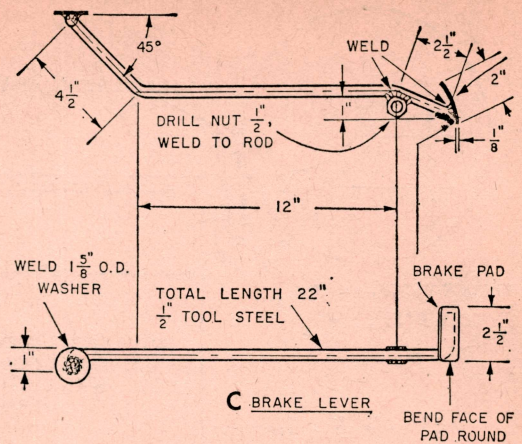
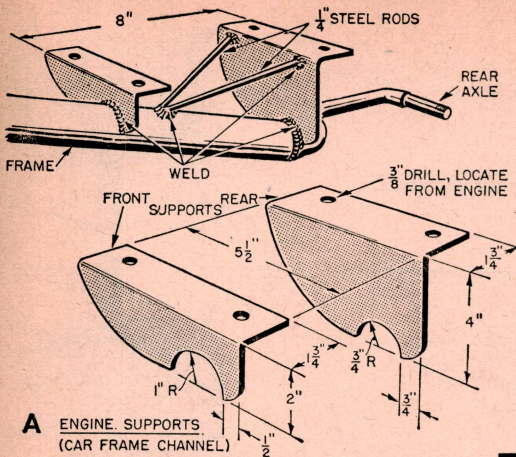
gasses away from the side of the car.

Handle Bars. Make the handle bars from a '48 Ford tie rod, bending and welding them as in Fig. 7B. Weld a $\frac{3}{8}$ x $2\frac{1}{2}$ -in. cap screw to the righthand side of the handle bar for mounting the throttle control handle (made from $\frac{3}{4}$ -in. conduit as in Fig. 7B). Weld the throttle-cable support to the underside of the handle bar and slide the cable through it. Thread or spot braze the end of the cable to the supporting $\frac{3}{8}$ -in. nut. The wire inside the control cable is fastened to the swivel clamp bolted to the conduit handle. Run the cable back along the cycle frame and connect it to the carburetor throttle lever. Disconnect and remove the engine governor linkage, and change the lever (B in Fig. 9).

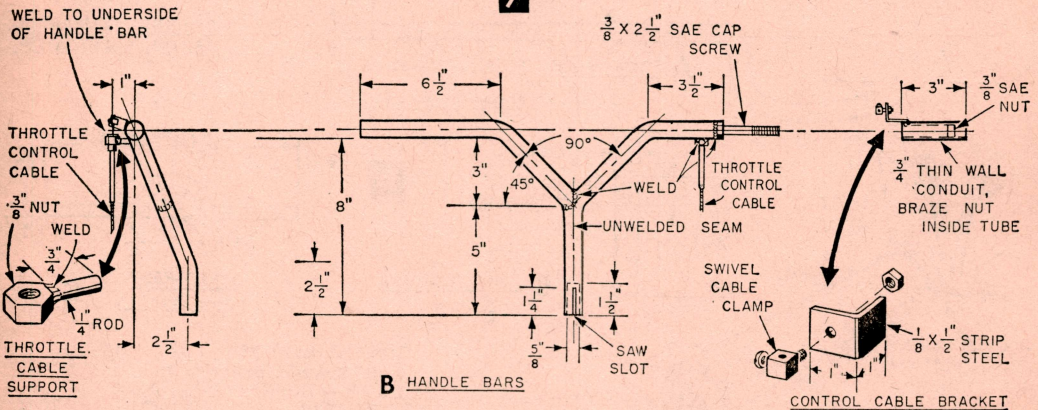
Fenders are required by law in some states for licensed scooters. We made ours from

pieces of car body sheet metal which is soft and can be easily cut and bent to the shapes shown in Fig. 8.

Brake. Be sure to use 1/2-in. round, water hardening tool steel for the brake lever because ordinary cold-rolled mild steel may bend out of shape and leave you without brakes. Make the brake as detailed in Fig. 7C and mount it on a 1/2 x 3-in. cap screw welded to underside of the frame as in brake assembly Fig. 6. Drill the threads out of the 1/2-in. hex nut welded to the foot brake so that the nut will slide on the cap screw. Then run a 1/2-in. hex nut on the cap screw to retain the brake lever. This same nut is used for the kick stand, too. Be sure the nut is on the cap screw before welding the kick stand (Fig. 6D) to it because it would be impossible to install the kick stand other-



7



wise. The nut must also have enough thread drag or friction to hold the kick stand in the up position. If the nut is too loose, collapse it slightly by squeezing in a vise before installing it.

With the exception of lights and a horn, required by some states before you can get a scooter license, your powercycle should be complete and ready for a test run. The horn can be the rubber bulb type available at auto parts and dime stores. The lights (head light and tail light) can be operated by a #6 dry cell battery or the type used for bicycles.

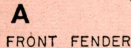
Side Cart. The best procedure to follow in making and assembling the side cart to the powercycle you have built is to cut and fit the four cart frame pieces (Fig. 2) individually. Start by making the axle extension from a 20½-in. length of ½-in. iron pipe. Weld a ⅝ x 2½-in. cap screw on one end, and heat and flatten the other end. Make up three cart attachment lugs as in Fig. 2B and bolt one to the flattened end of the axle extension. Then, with the wheel mounted on the axle extension and the cycle blocked in the upright position on the floor, place the lug end of the axle extension against the

rear axle arm of the cycle as in Fig. 2. Cut a couple of 2 x 2 in. blocks to hold the axle extension level with the floor and at right angles to the cycle frame. If you are doing your own welding, tack-weld the lug to the rear axle arm of the cycle. Otherwise, clamp or wire the lug to the arm.

Caution: Welding near a gasoline tank can be dangerous business. Be sure to drain gasoline from engine gas tank and carburetor and blow out tank before welding, or better still, remove the engine from the cycle.

Next, make cart frame part X in Fig. 2. Bend and fit the end that is fastened to the axle extension first. Then bend, cut and flatten the end to be attached to the cycle frame with a lug as in Fig. 2C. Use blocks to hold part X level with the floor and tack-weld or temporarily wire the lug to the cycle frame.

Now cut and fit part Y in position, tack-welding or taping it with plastic electrician's tape to hold it in place. Follow by fitting part Z in place, fastening the end to the cycle seat support with a lug. Cut the triangular shaped pieces, which reinforce the cart frame and provide mounting-bolt holes for the cart box, and weld them to the frame members.



B REAR FENDER
(CAR BODY METAL)

9

B THROTTLE RE-WOR
(CLINTON A-400)

MUFFLER RE-WORK
(CLINTON A-400-490)

8

SECT.
A-A

$\frac{1}{8}$ " X 1" STEEL
FENDER BRACE
AND LICENSE
BRACKET

SIDE - CART
FENDER

The cart box is made of 1/4-in. exterior plywood reinforced with cleats at all inside corners as detailed in Fig. 2D. Bolt it to the frame with three 1/4-in. *fh* bolts. Make the cart fender (Fig. 8) from sheet metal as you

Sets of plans for building the powercycle and side cart are available from the designer for \$2, ppd. Send check or money order, no C.O.D.'s or stamps, to Joe McBride, 2631 Kensington Way, Stockton 4, Calif.

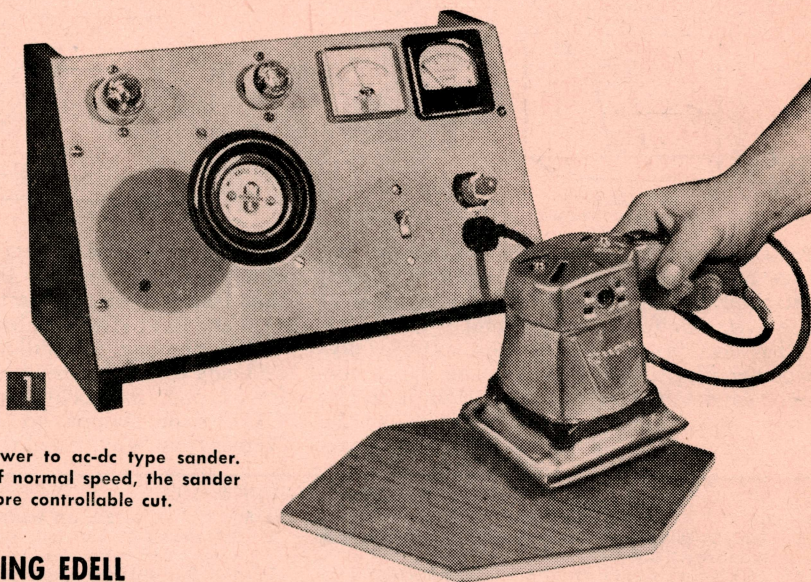
MATERIALS LIST—POWERCYCLE

No.	Req.	Size and Description	No.	Req.	Size and Description
1	1952-'54 Chevrolet propeller shaft with 1 1/4" stem for cycle frame and rear axle		1	5/8" bore x 1 1/8" O.D. ball thrust bearing (Catalog #605 available from local Boston Gear distributor)	
1	1949 Mercury sway bar for front fork and axle (1 1/16" O.D.)		1	1 1/4" O.D. plain steel washer for kick stand pad	
1	1935-'48 Ford tie rod for handle bars		1	1 5/8" O.D. plain steel washer for brake lever pad	
3	1935-'48 Ford tie rod clamps		2	5/8" I.D. plain steel washers for axles	
1	7" dia., V-belt water pump pulley from late model Chevy, Olds or Buick for rear wheel		2	5/8" castellated or slotted hex nuts to fit axles	
1	60" long choke or throttle control cable for engine carburetor control		1	3/8 x 2 1/2" SAE cap screw and nut for throttle handle	
1	V-Plex clutch with 2" pulley to fit your engine shaft (V-Plex Automatic Clutch Co., Hagerstown, Indiana)		1	1/2 x 3" SAE cap screw and two nuts for brake and kick stand	
1	1/2" V-belt. Determine length after installing engine		4	5/16 x 1 3/4" SAE cap screws and nuts for engine mounting	
1	Clinton A400, two-cycle gas engine. Other lightweight four-cycle engines up to 2 1/2 hp may be used also		2	3/4 x 3" bike handle grips	
2	4" cart wheels for 3.50" x 10" General Jumbo Jr., tires and tubes. Wheel hub must have precision ground ball bearings for 35 mph speed. 5/8" bore x 2" long hub length		2	1/2 x 3" bike handle grips for foot rests	
1	5/8 x 7" long mild steel round bar		1	3/8" hex nut for throttle support	
1	1/4 x 24" round tool steel bar (water hardening type) for engine bracket brace, kick stand and fender brace		1	4 1/2" length of 1/2" standard black iron pipe for fork bushing	
1	1/2 x 34" round tool steel bar (water hardening type) for brake lever and foot rest				
1	1/8 x 1 x 10" mild steel bar for license bracket				
1	3" length of 3/4" thinwall conduit for throttle handle				
1	1/8 x 2 x 2 1/2" mild steel for brake pad				
1	12 x 18" car body sheet metal for fenders				
2	engine supports cut from old car frame channel				

		SIDE CART
1	24" length of 1/2" standard black iron pipe for cart axle extension	
1	10' length of 1/2" thinwall conduit for cart frame	
1	1/8 x 1 x 20" mild steel bar for cart frame lugs	
3	5/16 x 1" SAE cap screws with Shakeproof nuts	
1	wheel and tire of the same type used on powercycle	
1	5/8 x 2 1/2" SAE cap screw and slotted nut for cart wheel axle	
1	1/4 x 36 x 48" exterior fir plywood for cart box	
1	3/4 x 3/4" x 12' lumber for cart box	
3	1/4 x 1 1/2" th stove bolts for cart box	
1	6" x 18" car body sheet metal for fenders	

\$5 Surplus Rheostat Builds This Power Control Panel

- lowers voltages
- dims photolights
- controls motor speeds



Control panel reduces power to ac-dc type sander. Operating at a fraction of normal speed, the sander takes a lighter, more controllable cut.

By **ERVING EDELL**

ORIGINALLY part of a heavy duty power panel that was built for the U. S. Navy, the rheostat in Fig. 2 constitutes the heart of a voltage control panel that has power handling capacity equal to similar units costing \$25 and up. It can be an invaluable aid to electronic technicians, appliance servicemen, and in the photography studio and darkroom as well.

Tests confirmed that the rheostat is capable of safely dimming two #2 photoflood lamps, each of which drew 4.2 amps. The control was smooth and practically stepless; and, with a load of 8.4 amps (over 1000 watts at 120 volts), there was no overheating of the resistance element. Thus the rheostat can be used to dim 1000-watt stage lamps, or control the speed of most small and medium size ac-dc type motors.

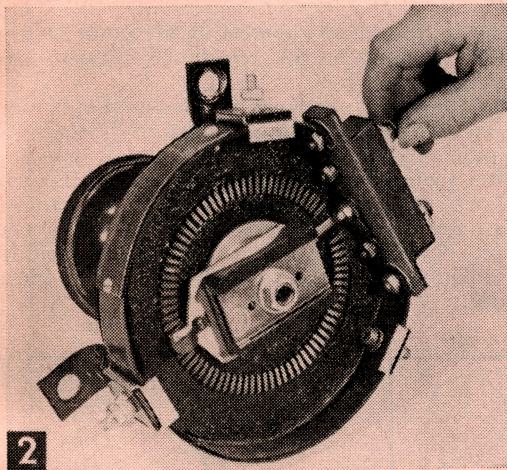
Radio-TV servicemen will find that this control panel provides a means of testing intermittent sets. By lowering the voltage, you simulate the conditions under which a set may fail when the line voltage in the home is low. Parts that perform satisfactorily at full line voltage may fail when power is reduced to 105 or 110 volts. This kind of test will also point out defective motors and appliances that are in need of servicing.

Construction Details. Since these rheostats were intended for ship installations, they were necessarily exposed to nearby switch-feeding cables that had been treated with a rodent-repelling poison. Be sure to clean the rheostat with benzene or carbon tetrachloride to remove any traces of the toxic substance, then wash and dry it thoroughly.

For purposes of economy, use *Masonite*

MATERIALS LIST

No. Req.	Description
1	Ward Leonard 117.6 ohm, 10 amp, 24 volt rheostat, available at Sidco Sales, 4751 N. Rockwell, Chicago 25, Ill., \$4.95 ppd.
3	1/4-20 x 3/4-in. bolts, nuts, and lockwashers to fit
2	7 1/2-amp household fuses and porcelain lampholders (G. E. 9402) or equivalent
1	DPST wall switch
1	duplex convenience outlet
1 pc.	1/4 x 9 1/2 x 16-in. Masonite or 1/8-in. aluminum (front panel)
2 pcs.	3/4 x 7 1/2 x 9 1/2-in. scrap wood (side panels)
3 ft.	#14 solid copper insulated hookup wire
8 ft.	heavy duty appliance cord with plug
Misc.	perforated sheet metal or screen wire to cover back, mounting screws, paint
Opt.	0-150 vac voltmeter, 1-10 ac ammeter

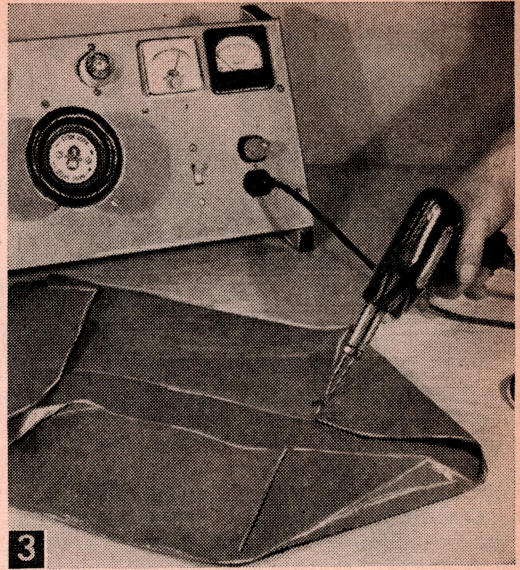


Rear view of rheostat shows mounting feet that can be reversed for mounting on bench or back of panel. An insulated 4-in. knob in front makes control easy.

with wood side pieces to build the panel as in Figs. 1 and 5. If you intend to use the rheostat in a rack, school lab, or for a stage installation, be sure to use aluminum or steel for the panel, since this will dissipate more heat. Ventilated metal enclosures are specified by the electrical code.

The rheostat has three mounting feet, which will have to be reversed in order to mount behind the panel as in Fig. 4. Drill a 1/2-in. hole for the shaft and ream slightly for clearance. Set the shaft in the panel, and mark the three holes for the mounting feet. Drill 1/4-in. holes and countersink them to fit 1/4-20 x 3/4-in. flat head (fh) machine bolts. Use lockwashers and bolt the rheostat in place.

Fuses Will Protect the Rheostat from accidental overloading which could burn it out. During a lab test, one of the rheostats was overloaded by attempting to use it to control a 1/2-hp lathe motor. The 10-amp household



Use the control with your soldering gun to reduce voltage when seaming plastic, or for soldering tiny transistors, diodes, and other small parts that can be ruined by excessive heat.

fuse which was in the circuit did not blow, so we suggest that you use either a 5- or 7 1/2-amp fuse.

Ordinary porcelain household type screw base lamp holders can be used to mount the fuses, and they are available for about 20¢ in any hardware store. You may even have a porcelain fuse cutout from a discarded electrical fuse box which can be used. Drill holes to fit in the panel, wire leads to the terminal screws, and fasten with two 8-32 x 1 1/4-in. fh machine screws. All wiring can be made from a 3-ft. piece of #14 solid copper insulated hookup wire, but use an 8-ft. piece of heavy duty appliance cord with plug for line voltage.

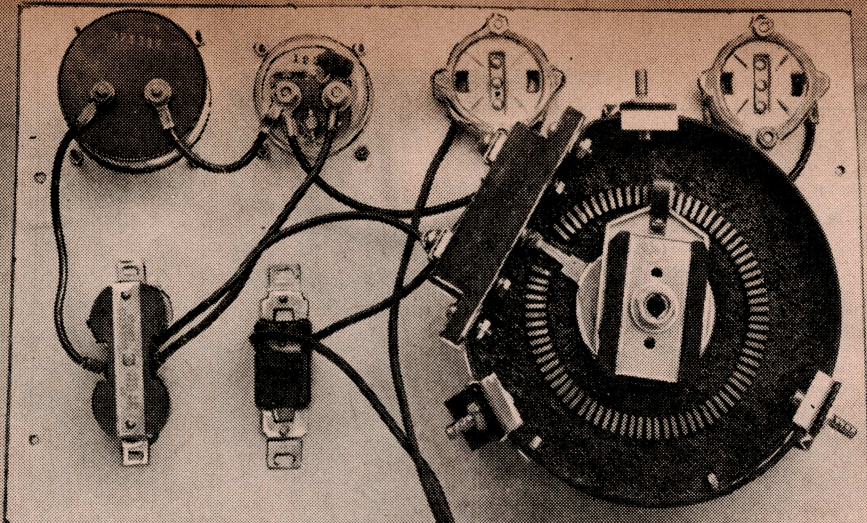
On the Masonite panel, no insulation is required. If you use a metal panel, however, you will have to make insulating washers or use standoff spacers.

Cut holes for the switch and duplex outlet. Since different makes vary in size, exact dimensions are not given. If you are buying new parts, select a heavy duty type double pole single throw switch.

The meters are optional equipment, and can be found in surplus stores, or purchased from electronic supply houses. A 0-150 vac voltmeter would be a valuable instrument to have on your panel. Also of use would be a 0-5 or 1-10 ac ammeter.

As an economy measure, a 10-watt pilot light can be installed in place of the meters to give you an indication of whether or not the voltage has been reduced. A neon bulb on a plug base serves as a useful pilot light,

4



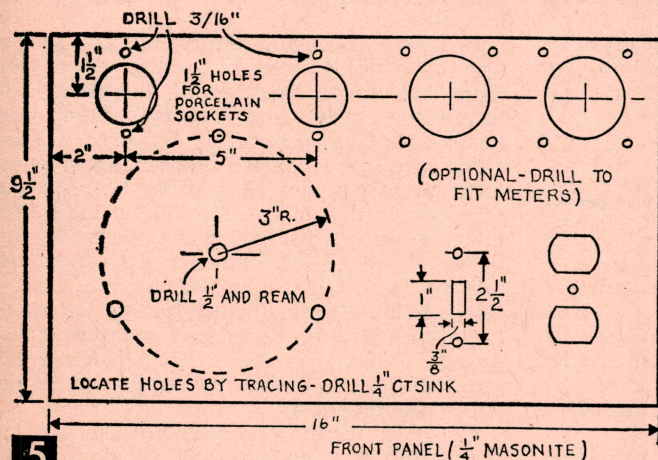
Rear view of control panel illustrates wiring.

but will not burn at less than 65 volts.

Operation Details. In feeding a small motor or appliance drawing less than 100 watts, you may find that the rheostat will not lower the voltage as much as desired. In this case, plug in lamps to act as an additional load. You'll find that by loading the circuit with various combinations of lamps, you'll be able to feed the outlet plug with any voltage from 0 to full line voltage. The control is very smooth; and, if you accidentally overload the rheostat, it can be repaired by soldering

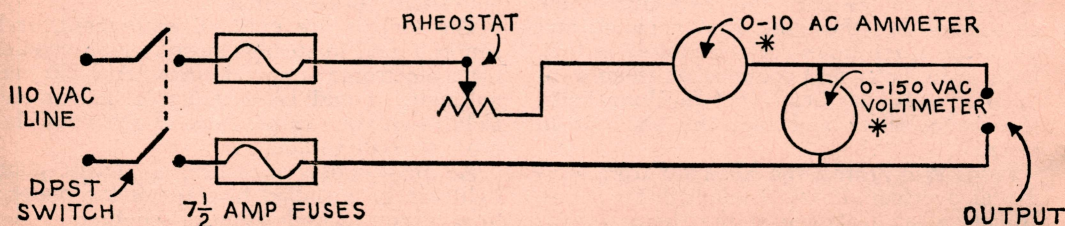
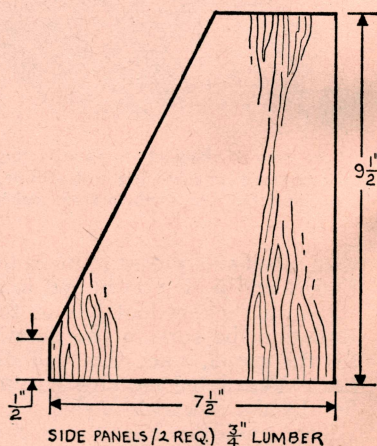
across the brass contacts at the point where the burnout in the resistance element occurred.

The power panel can be used with a bridge rectifier to supply direct current for operating surplus motors, experimental dc apparatus, plating, and other equipment. With such hookups, always be sure to turn the control all the way down before turning the power on. By doing this, you will avoid feeding too high a voltage to parts that could burn out.



5

CHASSIS DIMENSIONS



* METERS ARE OPTIONAL
(SEE TEXT)

6

SCHEMATIC



Opaque specimens must be lit from above for micro-viewing. This micro-illuminator, designed by an expert in microscopy, greatly increases the usefulness of any microscope.

Convert Your Microscope with a MICRO-ILLUMINATOR

USE IT FOR—

- Opaque viewing of metallurgical and geological specimens •
- Oblique (above stage) illumination of fibrous materials •
- Controlled sub-stage illumination for transmitted-light viewing •

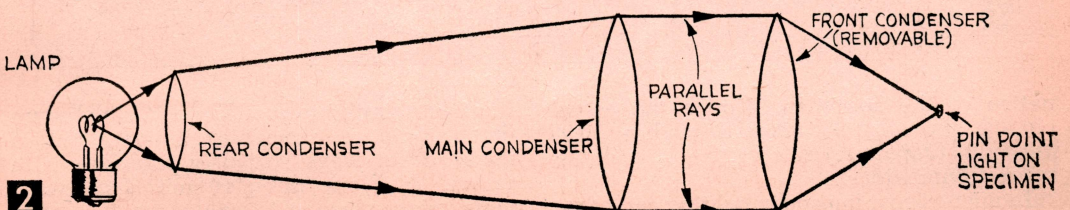
By HERBERT C. MCKAY FPSA FRPS

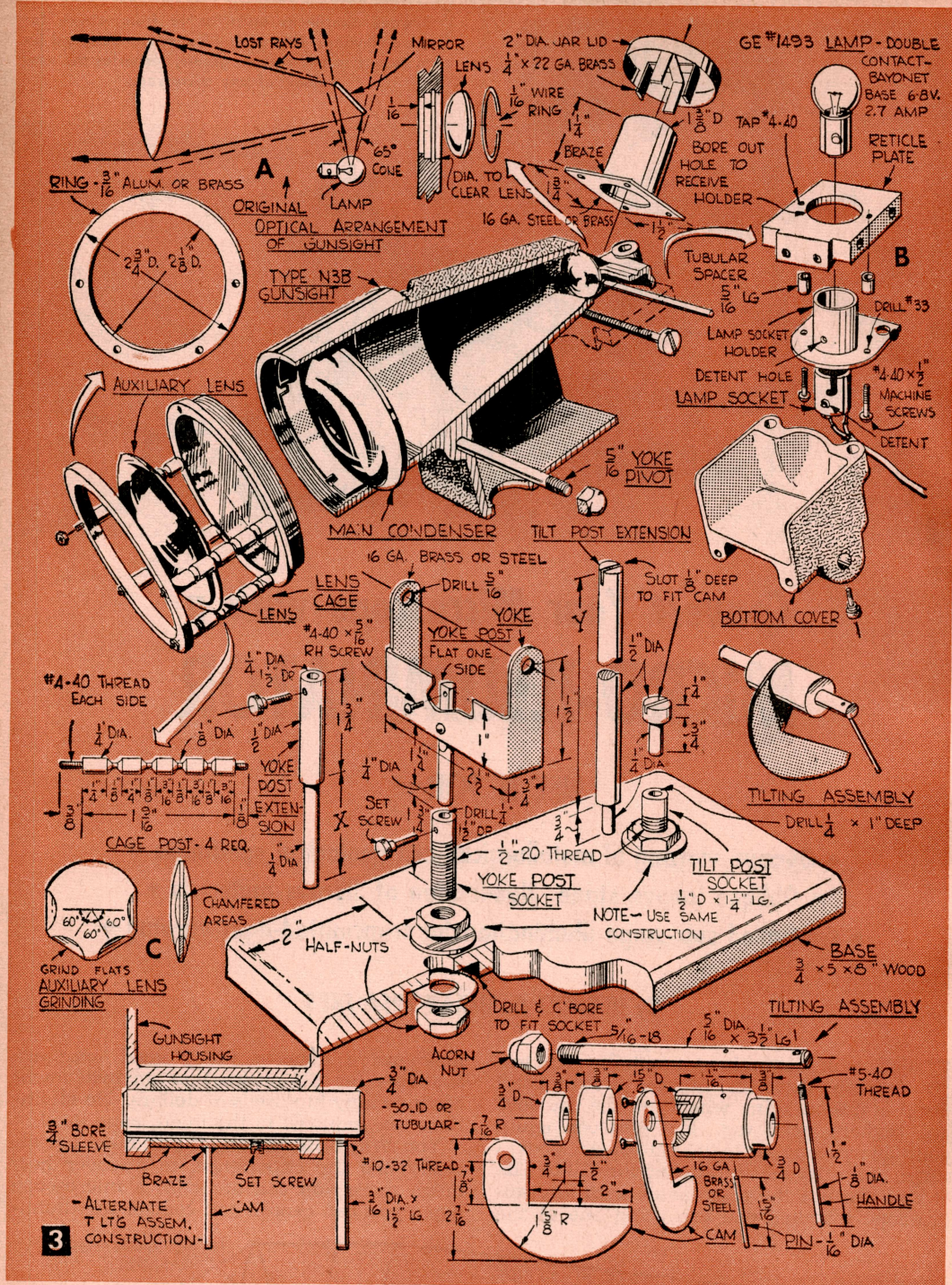
EVER look longingly at a metallurgical microscope fitted for internal illumination? It's discouraging when you see the \$600 (or higher) price tag. But you can equip your own 'scope with this sub-stage, above-stage, and internal illuminator for \$10 to \$15.

You can use the illuminator with any microscope whether you are using one of the

inexpensive imports (very good ones are available for \$20 or less) or an instrument costing many hundreds of dollars. No alterations are required to the microscope itself.

You Will Be Amazed, if you have not already had the experience, to discover how much more you can see with a microscope when you can choose and control the illumi-

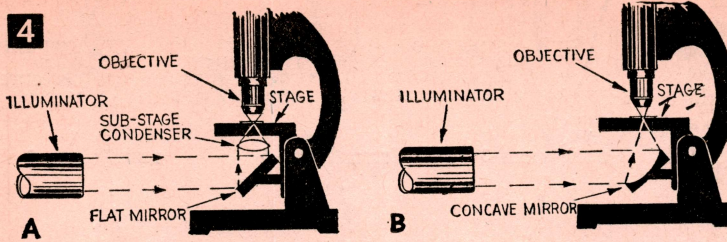




nation of the specimen. Notice the actual photographs (Fig. 5), taken through a \$19.95 Micronta (Japanese) microscope lit with our micro-illuminator.

In microscopy, improper lighting can cause

fuzziness, similar to poor focus; it can obscure detail, produce excessive contrast, and in many other ways seriously interfere with vision. And one thing is most important: more micro-viewing is spoiled by *too much*



light than by not enough!

The Main Thing Is: *The light should be concentrated upon the specimen.* To do this, we will construct a lens system like Fig. 2, in which light rays leaving a lamp filament are successively bent by several condensing lenses into a cone of light focused on the specimen under examination.

The third lens of this system can either be mounted in line with the first two for above-stage illumination, as shown in Fig. 2, or mounted as a sub-stage condenser to concentrate the light reflected from a plane mirror up through the specimen (Fig. 4A). In microscopes having a concave mirror (Fig. 4B), the third condenser is not required.

A Refinement that greatly improves seeing with a microscope is a glare stop. Figure 6 shows how this functions. At A, without the glare stop, light rays G-G illuminate portions of the slides outside the specimen X and pass outside the objective lens. These rays cause glare, and the specimen appears dim. At B a plate with a circular opening in it has been positioned so as to cut out the glare rays; but even so, the specimen will appear too light and with little detail. At C a smaller stop, illuminating about four-fifths of the objective lens, gives brilliant detail. Lighted this way, the specimen should appear like a large object viewed without any microscope. A smaller stop (or diaphragm) would give insufficient light and would obscure detail.

Some microscopes have the sub-stage mir-

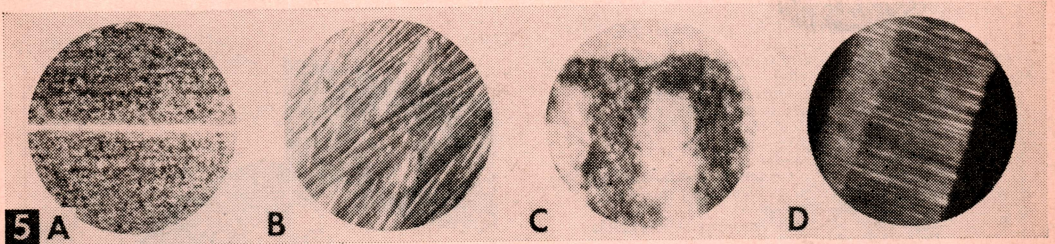
ror mounted to permit moving it from side to side, a makeshift way of obtaining oblique illumination. For our purposes, make sure the mirror is located centrally, so the central ray of light will travel in a straight line from the mirror through the specimen

and microscope tube, and emerge from the center of the eye lens. When this is not done, detail is invariably lost. You will overcome the major part of lighting troubles if you keep the mirror centered and prevent glare.

To Get Started on your own micro-illuminator, dismantle the surplus gunsight you have secured (see Materials List). In the gunsight as originally built, light rays from a bulb are reflected at 90° by a mirror and then pass out through the single lens (Fig. 3). A large portion of the rays produced in a 65° cone are lost, as can be seen. We will bring it into conformity with Fig. 2, where the rays in a 65° cone (about the maximum that can be used) are converged to produce either a parallel-ray beam, or a pin-point spot.

These gunsights vary in design to some extent but only in minor details. For example, some have a sheet metal lamp house held in place by two springs; others have a cast cover secured by four screws. This article is based on the latter type. Note, however, that the basic changes apply to all these units regardless of minor design differences. The sheet metal covered type has no traverse screws, and the reticle plate is held permanently by two screws, but the basic operations remain the same.

Remove and discard the sloping mirror and mirror cover—these will later be replaced with a lamp chimney. Discard also the reticle, an etched glass plate between the lamp and the mirror, but keep the reticle plate. This



A. Steel, etched with hydrochloric acid. Photo made with oblique light at 50X magnification. White line is a scratch.

B. Sanded aluminum. Note two directions of scratches. Photo made at 50X with oblique light.

C. Part of the letter "n" on ordinary newsprint. Note better definition on inked portions. Oblique light at 50X.

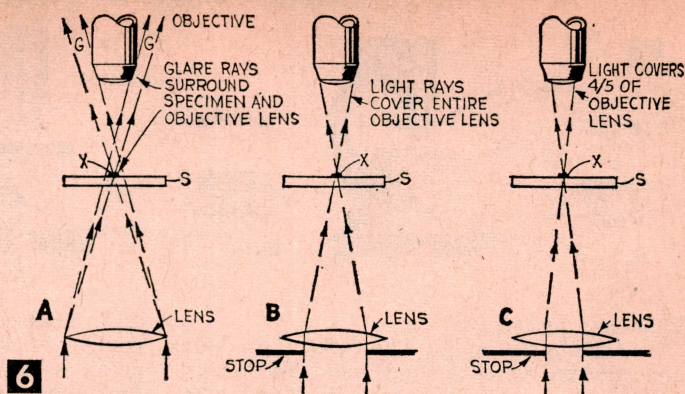
D. Edge of a razor blade at 100X. Oblique light brings out hone scratches clearly.

slides on a smooth pin and a traverse screw, and this assembly will be kept for remounting the lamp socket holder. To get the traverse screw out, it will be necessary to push out a small retaining pin which secures the knurled knob on the end of the screw.

The Small Lens immediately in front of the lamp must have a diameter which can be fitted into the lamphouse, that is, about 23 to 25 mm, and its focal length should be relatively short, but variations in the focal length given in the Materials List of up to 20% will not seriously affect the result. To install this lens, chuck the housing in your lathe and, with a small boring bar, cut a recess in the housing (Fig. 3) to receive the lens. Then cut a $\frac{1}{16}$ -in.-wide groove in the opening to take a wire snap-ring. This will hold the lens in place.

After removing the reticle plate, enlarge the hole in it so the lamp socket holder will just fit in it (Fig. 3). Drill two holes in the lamp socket holder flange, and drill and tap two corresponding holes in the reticle plate to take 4-40 screws. Make two $\frac{3}{16}$ -in.-long tubular spacers and mount the socket holder as shown in Fig. 3 on the underside of the reticle plate with two 4-40 x $\frac{1}{2}$ -in. machine screws. Then mount this assembly in the gunsight.

Testing. Install the socket, wire it to a 6.3-volt 3-amp transformer (see Materials List) and insert the new lamp (Fig. 7). Hold a white card in front of the sight and, with the lamp lit, notice whether the image of the lamp filament is centered in the light spot on the card. Both the main condensing lens and the



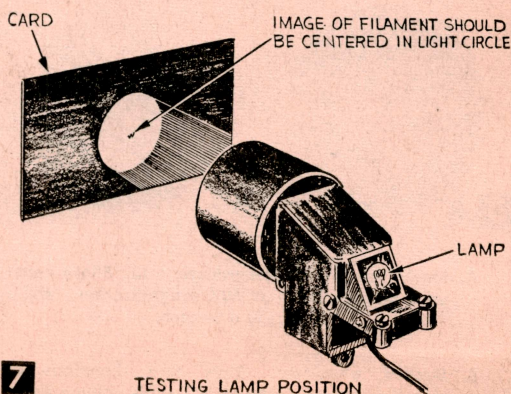
small one near the lens must be in place for this test. Move the lamp vertically (by sliding) and horizontally (with the traverse screw) to accomplish this. You will probably find that the filament is *not* in the lamp's center, so it may be necessary to set the lamp itself off-center. Then, by careful measurement, find the location of the spring detent in the lamp socket and drill a corresponding hole in the socket holder. This will ensure that the lamp will be maintained in correct position. Now the bottom cover can be replaced.

To protect and ventilate the lamp a chimney is required. Make this of brass plate and a short brass tube (Fig. 3), silver-soldered together. Make a light-trap cover out of a tin jar lid of about $\frac{1}{4}$ to $\frac{1}{2}$ in. greater diameter than the tube. Two brass or sheet steel strips bent to shape and riveted to the cover hold it in place. Take care not to push the cover all the way down when the lamp is lit, as this would stop ventilation.

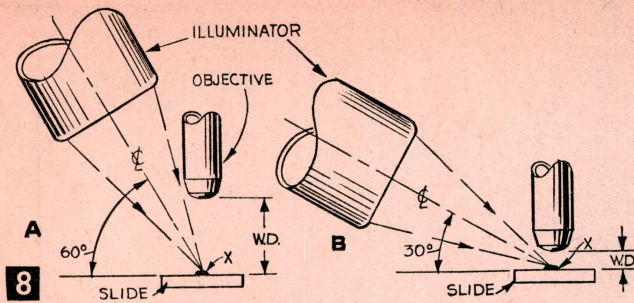
For Sub-stage Illumination you will want an option of having a parallel-ray or pin-point light beam. Above the stage, and for internal vertical illumination you will use the pin-point beam only. To get this variability, a third condensing lens is mounted on a bracket on the front of the illuminator. Almost any

MATERIALS LIST—MICRO-ILLUMINATOR

Amt. Req.	Size and Description
1	*illuminated gunsight (Edmond #50052)
1	*condenser lens, PCX, 23 mm x 41 mm
1	*condenser lens, $2\frac{1}{8}$ x $3\frac{1}{4}$ " (Edmond #1160)
1	GE #1493, DC bayonet base lamp, 6.8V, 2.7A
1	*filament transformer 6.3V, 3A (Allied #62G031)
1	$3\frac{1}{2}$ x 5 x 8" wood—base
15 in.	$\frac{1}{2}$ " dia. brass, steel, or aluminum—sockets and posts
12 in.	$\frac{1}{4}$ " dia. brass or steel—yoke rod, lens cage
7 in.	$\frac{5}{16}$ " brass or steel—yoke and tilt pivots
1	3 x 7" x 16 ga. brass or steel—yoke, cam
5 in.	1" dia. brass, steel, or aluminum—pivot
3 in.	$\frac{1}{8}$ " dia. brass or steel—pivot lever
1 in.	$\frac{1}{8}$ " dia. steel pin—pivot
1	$\frac{3}{16}$ x $2\frac{3}{4}$ x $2\frac{3}{4}$ " aluminum or brass—lens cage ring
1	13" dia. x $\frac{1}{4}$ " brass tube—lamp chimney
1	2" dia. jar lid—lamp chimney
5 in.	$\frac{1}{4}$ x 22 ga. steel or brass—lamp chimney clips
4	$\frac{1}{2}$ -20 half-nuts—sockets
3	8-32 x $\frac{1}{4}$ " knurled-head thumb screws—yoke, pivot
10	4-40 x $\frac{5}{16}$ " rh machine screws—yoke, chimney
3	$\frac{5}{16}$ -18 acorn nuts—yoke and tilt pivots
2	4-40 x $\frac{1}{4}$ " rh brass or steel machine screws—cam
8	4-40 hex nuts—lens cage, chimney
Misc.	black wrinkle varnish, dull black optical lacquer
	*Edmond Scientific Co., Barrington, New Jersey
	**Allied Radio, 100 N. Western Ave., Chicago, Illinois



TESTING LAMP POSITION



small magnifier of 3- to 6-in. focal length and $2\frac{1}{8}$ - to $2\frac{1}{4}$ -in. diameter will do for this, or you can get the one in the Materials List.

To mount this lens, make four grooved posts threaded 4-40 on the ends (Fig. 3). The plane glass mount that comes with the sight has six threaded holes in it. Tap four of these 4-40, and screw the grooved posts into them. This plane glass will have no optical effect on the system and can remain in the mount. Make a ring of aluminum or brass drilled to receive the outer ends of the grooved posts, and attach it to them.

If you are using the condensing lens listed for this third lens it will drop into place in the post grooves, but you can use a smaller one by mounting it in a cardboard or metal ring, or a slightly larger one (as we did) by grinding its edges (Fig. 3C) so it will drop into place between the supporting posts, with its optical center in line with the optical centers of the other lenses. You will need only to grind the lens edge at four places 60° apart (the spacing of the cage posts) just enough to let it enter the cage grooves. Use a slow-speed soft-bond (or lapidary grade) wheel, keep water flowing over the lens while grinding, use *light* pressure, and keep the lens edge parallel to the wheel motion. For a high finish, re-grind the lens edge with a fine rubber-bond wheel and polish with rouge.

Make the base of $\frac{3}{4}$ -in. wood, 4 x 5 in. (Fig. 3). To support the illuminator above the base, make the yoke of $\frac{1}{16}$ -in. brass, steel, or aluminum, dimensioned and bent to shape as shown in Fig. 3. Attach the $\frac{1}{4}$ -in. brass post to it with two 4-40 x $\frac{1}{16}$ -in. rh machine screws.

From $\frac{1}{2}$ -in. brass or steel machine the sockets for the yoke support and tilting post. These sockets are the same except for length. Thread the lower end of each to take $\frac{1}{2}$ -in. half-nuts, add $\frac{1}{2}$ -in. iron washers, and mount them in $\frac{1}{2}$ -in. holes in the base. The lower ends of these holes are counterbored to recess the nuts (Fig. 3).

For sub-stage lighting the yoke-rod fits directly in this socket, but for above-the-stage work an extension is required. Determine the length of this extension (X, in Fig. 3) by focusing a pin-point of light on the microscope stage, with the illuminator held at a 60° angle.

This will be the highest point at which it will be necessary to support the unit. For heights less than this, note that the upper end of the yoke-rod extension is bored and provided with a thumbscrew, to allow about 1 to $1\frac{1}{2}$ in. of vertical adjustment.

Make the Tilting Assembly (Fig. 3) next, using either of the constructions shown. For that matter, any other construction that accomplishes the same purpose is all right. With the tilting

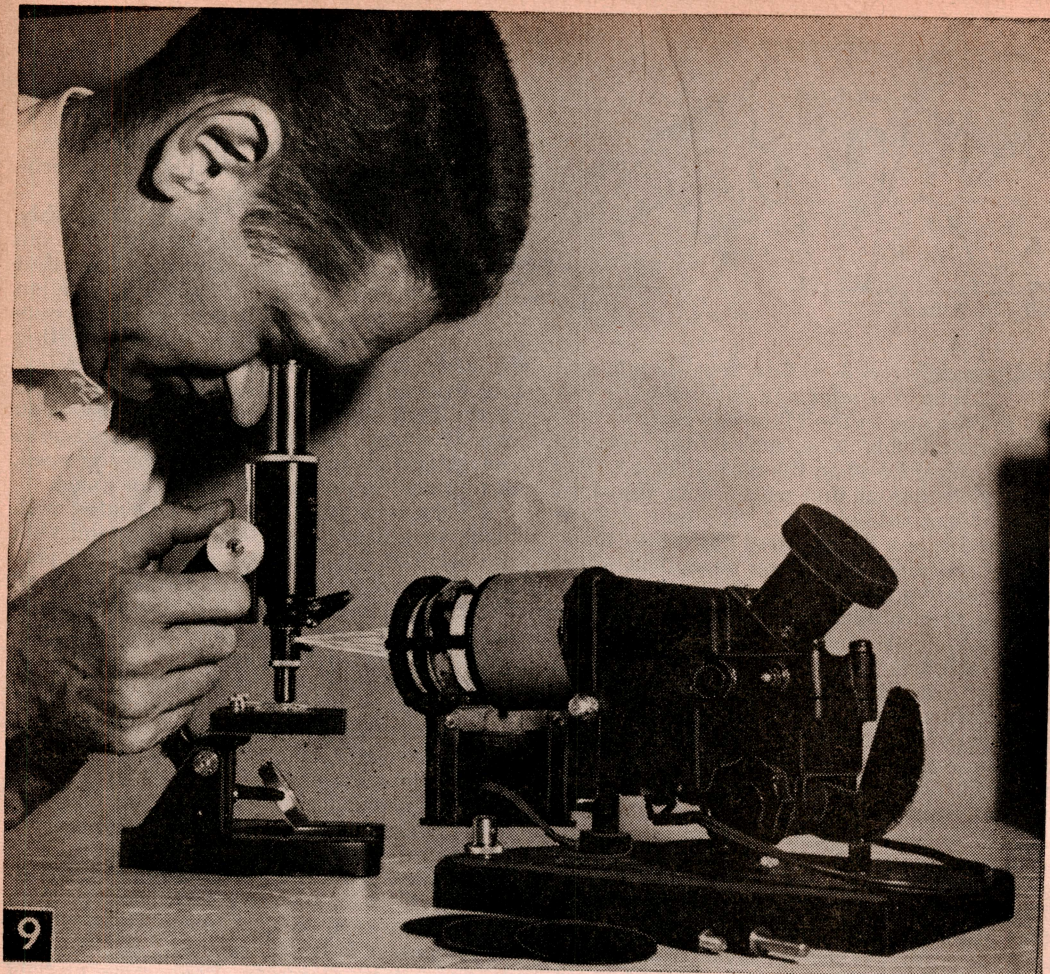
assembly in place and the illuminator tilted and focused as before, determine the length of the high tilting post (Y, in Fig. 3). You can, of course, make as many of these yoke rod extensions and tilting posts as you need, to support the unit at any height or angle.

All the new parts can now be coated with black wrinkle varnish, which will blend with the original finish on the gunsight and give a professional appearance to your illuminator. Paint interior surfaces with dull black optical lacquer from your photo supply store.

One Additional Accessory is required to complete the unit for sub-stage and above-stage oblique lighting: some means of narrowing the light beam. Many high-power objectives work better with the light beam limited by a small aperture, such as is found in the aperture ring beneath the stage of many microscopes, but it is still better to have the beam limited at the lamp as well. You can make $2\frac{1}{4}$ -in. diameter discs of thin aluminum of $\frac{1}{16}$ -in. opaque plastic sheet or even heavy cardboard, painted black. These should have central holes of, say, $\frac{1}{8}$ -, $\frac{1}{4}$ -, $\frac{3}{8}$ -, $\frac{1}{2}$ -, 1-, and $1\frac{1}{2}$ -in. diameter. They serve as field diaphragms to further reduce glare.

A word or two is necessary about using the illuminator above the stage when viewing opaque specimens. Brilliant lighting with good shadow relief is obtained when the illuminator is at an angle of 60° (Fig. 8A), and a low-power objective lens is in use, permitting a high working distance (W.D.). But, when a higher power objective is used, the W.D. decreases, forcing a lower angle of incidence of the cone of light, such as the 30° shown in Fig. 8B. At this angle the lower rays of the cone cast shadows of the rougher parts of the specimen which interfere with viewing. Further reduction in the W.D. will either produce very unsatisfactory shadow conditions or cause the objective lens to interrupt the light cone.

To solve this problem, Part 2, immediately following, will describe the construction and use of a vertical illuminator. This device will allow light to be directed vertically against the specimen from within the microscope, for high-power examination of metalurgical and geological specimens.



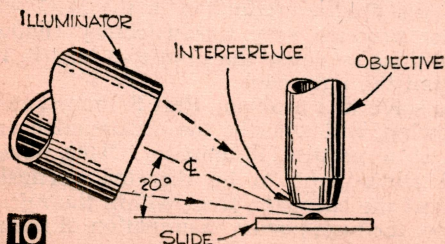
Part 2

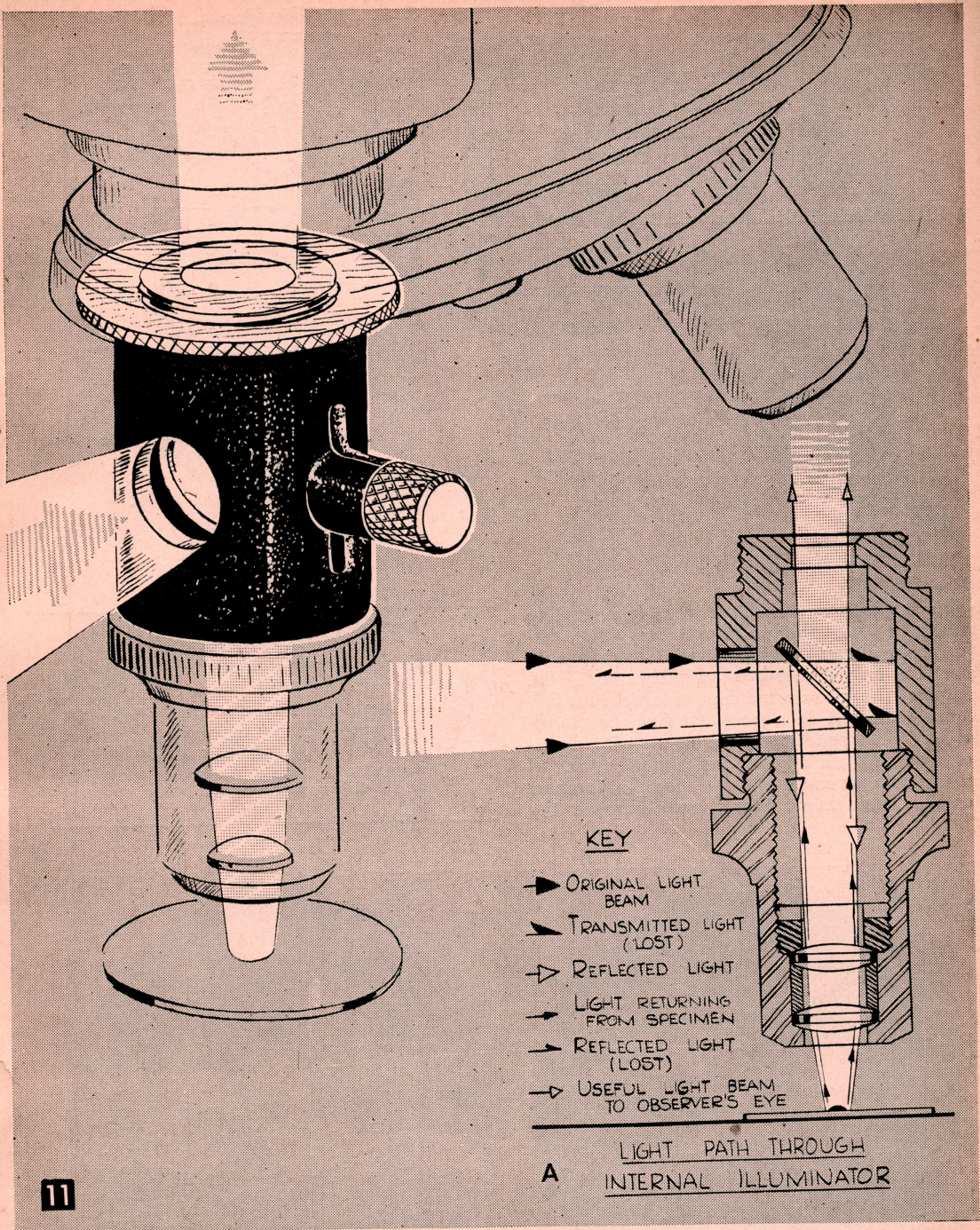
Internal illumination paves the way for advanced microscopy: viewing opaque metal and rock specimens, and making photomicrographs.

YOU are well on the way toward professional microscopy when you use the microscope illuminator described in the preceding article. Now, for mere pennies, you can add the internal illuminating attachment (Figs. 9, 11, 12) which allows you to light up opaque specimens from within your microscope in a manner similar to that of the most expensive metallographic microscopes. Obliquely lighting opaque specimens is un-

satisfactory when high power objectives are used, on account of the low working distance (WD, Fig. 10) and the consequent interference with the lightcone coming from the illuminator. The low WD also compels a low light-angle, and while this is useful in lighting certain low-relief specimens, for many others, vertical illumination of higher intensity is preferable.

Figure 11A shows how the internal illuminating attachment works. A light beam enters through an opening in the side of the attachment and strikes a slanted glass plane reflector. Part of the beam passes through the glass, but the remainder is reflected down through the microscope objective onto the specimen. A portion of this light is reflected back up through the objective. Again, part of the light is reflected and part passes through the slanted glass. This time, the part of the light that passes through is the useful





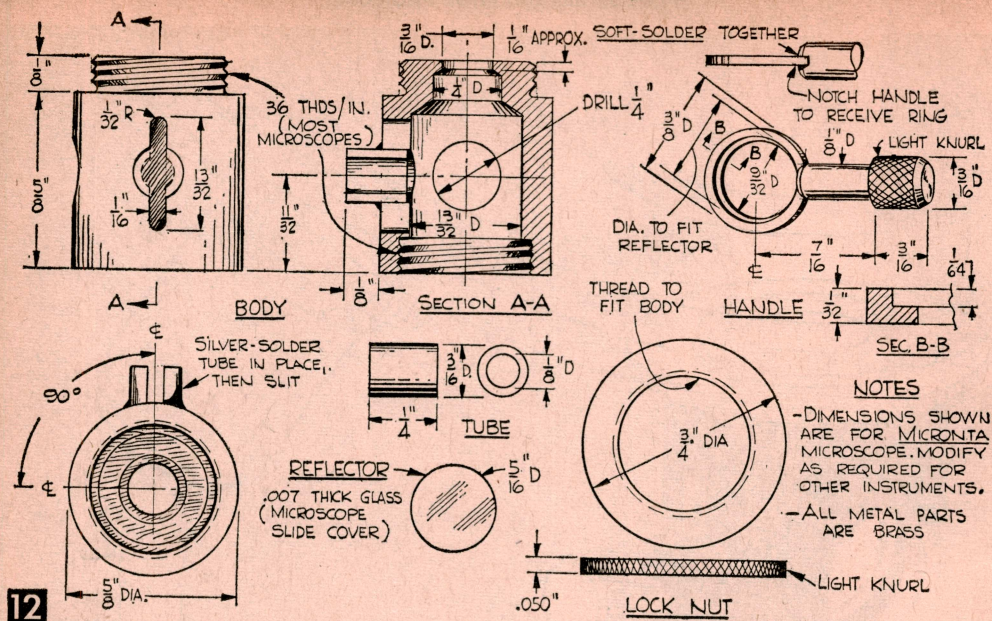
part, as it continues up through the eyepiece of the microscope to the eye of the observer. Thus, light is introduced into the microscope directly in the line of vision, but without interfering with it.

This attachment can be removed from or attached to the microscope in moments, and while it changes the length of the optical

system when it is in use, this change is readily compensated for by a slight adjustment of the microscope focusing knob.

Making the Attachment. NOTE: The dimensions given here were worked out for a Micronta (Japanese) microscope. If your microscope is one of the inexpensive imports, it will probably be similar in size to ours, and

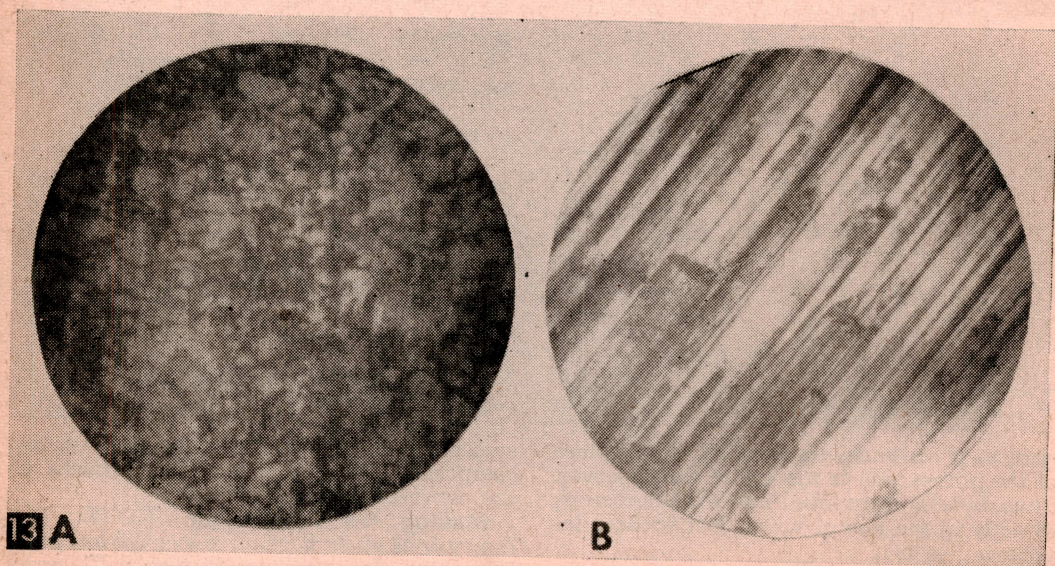
SURPLUS and SALVAGE PROJECTS



you can follow the dimensions given. The threads on the objectives, however, may differ so be sure to check these. Ours were 36 per inch on a diameter of slightly over $\frac{1}{2}$ in. Most of the more expensive microscopes follow the Royal Microscopical Society standard of 36 threads per inch, on a major diameter of 0.800 in. If your instrument is one of these larger ones, make the outside diameter of the attachment 1 in., and increase the

MATERIALS LIST—MICRO-ILLUMINATOR

Amt. Req.	Size and Description	Use
1	$\frac{3}{4}$ " diameter x $1\frac{1}{4}$ " long brass	body and nut
1	$\frac{3}{16}$ " diameter x $1\frac{1}{2}$ " brass rod	reflector handle
1	$\frac{3}{8}$ " diameter x (1" nominal) brass rod	and sleeve
several	* 0.007" thick microscope cover glasses	reflector ring
Misc.	cellulose cement, rubber cement, hard solder, soft solder, dull black instrument lacquer	reflector
	* Obtainable from Edmund Scientific Co., Barrington, N. J. (100 for \$1.30), or your local microscope supply store	



Two photomicrographs made with the aid of the vertical illuminator: (A) Steel etched with nitric acid, at 200X; (B) Brass polished and lacquered, at 50X.

other dimension accordingly.

Check the threads on your microscope with an accurate machinist's scale and a small magnifier. Then start work on the body of the attachment by chucking it in your lathe and boring it to the proper internal diameter (Fig. 12).

Threading. Cut the external and internal threads on the body according to Fig. 12. Because of the fineness of these threads, ordinary threading tools will not work. Figure 16 shows how to grind a $\frac{1}{4}$ -in.-square cutter bit for the external male thread, and a $\frac{1}{4}$ -in.-diameter internal tool for the female thread.

Run your lathe slowly, about 30 to 50 rpm, for this work, and take light cuts. An aluminum pencil mark on the shank of the internal threading tool will serve as a visual warning, when it aligns with the end of the body, that the tool has been run in far enough.

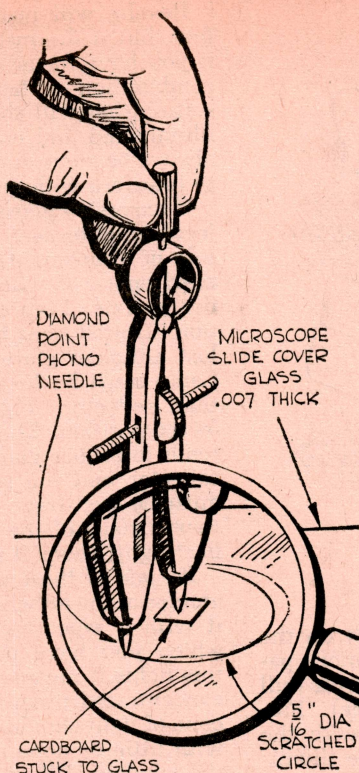
Make the knurled lock-nut (Fig. 12A) out of $\frac{3}{4}$ -in.-diameter brass stock. Don't forget to do the knurling *first*, then bore, thread and cut off.

Drill two holes, one $\frac{3}{16}$ in. and the other $\frac{1}{4}$ in. diameter, at 90° to each other in the sides of the body (Fig. 12). Slot the $\frac{3}{16}$ -in. hole vertically by drilling $\frac{1}{16}$ -in. holes where shown and filing out (with a thin flat file) the metal between. This slot will provide entry for the reflector.

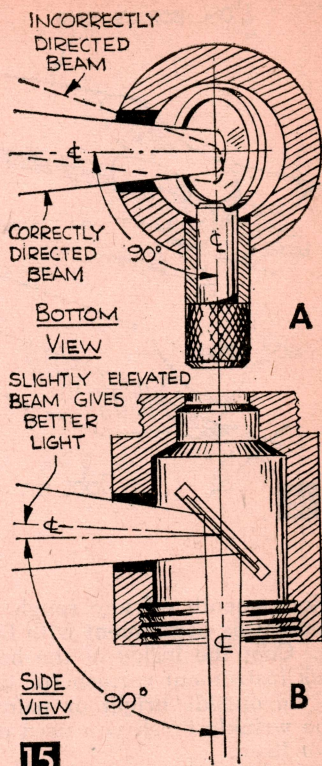
Make a brass tube (Fig. 12B) and press it in this hole. It must stand true, at 90° to the body. Silver solder the tube in place. Remember, when silver soldering (hard soldering), to have the parts perfectly clean. Flux them with hard solder flux or a paste of common borax and water, and place small bits of silver solder (about $\frac{1}{8} \times \frac{1}{16}$ in.) in contact with the intended joint. Then heat the assembly with an acetylene or propane torch. As it approaches a red heat the solder will melt and run into the joint.

Then slit the tube to correspond to the slit in the body.

Reflector Holder. For this, use $\frac{3}{16}$ -in. brass rod (Fig. 12). In order to ensure a snug



14 CUTTING THE REFLECTOR

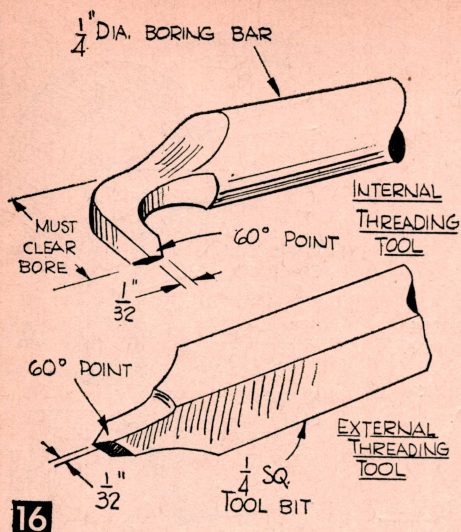


15

fit of this part in the slit tube, machine the shank diameter cautiously, and finish it by filing or with emery paper.

Reflector. You can make this seemingly difficult part with surprising ease out of a 0.007-in.-thick microscope slide cover glass with the aid of a diamond point phonograph needle. Mount the needle in a small compass. With rubber cement, stick a tiny piece of cardboard to the microscope cover glass. Pivot the compass in the cardboard and carefully scribe a $\frac{3}{16}$ -in. circle on the glass (Fig. 14). Then peel off the cardboard and break away the outside portion of the glass, using fine pliers. Several trials may be required to get a good reflector (the author got 6 useable ones out of 10 cover glasses). Small points on the edge of the reflector can be smoothed off with a fine pocket hone.

To mount the glass reflector, make a brass ring (Fig. 12). Cut the recessed internal diameter of the ring to fit the reflector. Soft-solder the ring to the holder; hard solder requires too high a heat for these fragile parts. Check the fit of the completed holder in the slit tube before mounting the glass. The ring, when turned 90° to the body axis, should be centered in the bore. Use cellulose cement—two tiny drops are enough—to secure the glass in the holder.



Results will probably be discouraging at first, but if the inside is well blackened, and if you have focused the lens, you will find a combination of lamp position and reflector setting that will show the specimen brightly illuminated and clearly defined. There will always be some surplus light but not enough to interfere with good vision.

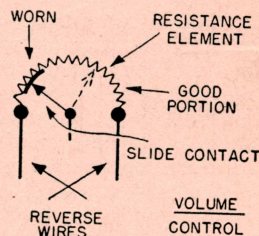
If excessive glare is encountered or the object cannot be seen, check these points: 1. Inside of attachment should show no unblackened spots. 2. Lamp must point 90° to reflector axis. Figure 15A shows correct position. Dotted light beam in wrong position is lost although glare is as strong as ever. 3. Lamp must be level with or slightly higher than reflector. Figure 15B shows the preferred position. The slightly elevated position tends to reduce glare. 4. Both surfaces of the reflector and the rear lens of the objective must be dust-free. Keep them clean. 5. The rear surface of the objective mount may reflect light; cover it with the dull lacquer.

If none of these help, try reducing the diameter of the attachment window by covering it with a taped-on piece of black paper in which you have punched a $\frac{1}{8}$ -in. hole. If this helps it means the filament image is not concentrated upon the reflector. The whole cone of light should pass through the window with little or none of it striking the edges of the window. When light enters which is not reflected, it spreads to produce glare. Keep the beam concentrated upon the reflector. To avoid inadvertently moving either the microscope or the illuminator, you may wish to clamp them to your worktable top.

Once you find the correct adjustment you can return to it with little difficulty, so do not lose patience if at first you have some trouble in adjusting the illuminator. With it you can see a microscopic world that would otherwise be closed to you. Metallurgical specimens viewed with the internal vertical illuminator are shown in Fig. 13.

Salvaging Worn Radio-TV Control

- When a volume, tone, or other radio-TV variable resistance control becomes worn and gives spotty operation that can't be eliminated with control cleaner, try reversing the two outer wire connections (see sketch). This will put the operating range of the control on the least-used portion that is still serviceable and salvage the control for further satisfactory use. —JOHN A. COMSTOCK.

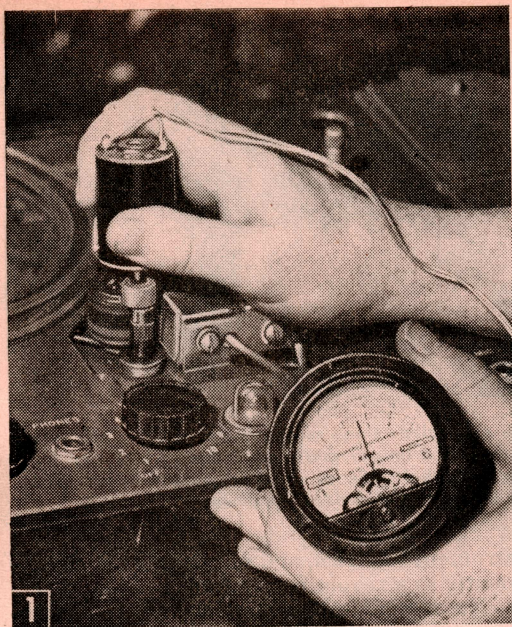


Now smooth off any rough edges on the illuminating attachment with fine emery paper. Coat the inside of the body with dull black instrument varnish (or lacquer). Finish the outside bright or paint it with the same wrinkle finish you used on the illuminator itself.

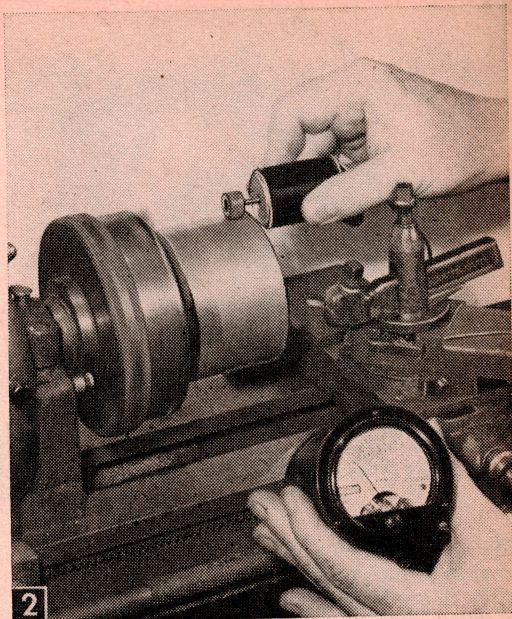
Using the Internal Illuminator. Screw the attachment into one of the objective openings in the microscope nosepiece, using the lock nut to fix it in the desired operating position. Figure 9 shows a convenient arrangement, with the illuminator positioned in front of and slightly to the right of the microscopist, and the reflector handle pointing 90° anticlockwise from the illuminator. It is best to remove the other objectives from the nosepiece when using the illuminating attachment.

Screw the desired objective into the lower end of the attachment, and be sure to raise the microscope barrel enough for the assembly to clear the stage and slide when it is in operating position.

Set the illuminating lamp in its low position and direct a pin-point of light (using the auxiliary lens) into the attachment window against the reflector. Turn the reflector to about 45° to the light beam so the light is directed down through the objective. Now remove the eyepiece and look down into the tube. Carefully turn the reflector until you can see the objective brightly lighted. Replace the eyepiece and look into the lens. You will probably see nothing but a bright glare. Turn the reflector carefully back and forth. If you see nothing after focusing, change the angle of the lamp slightly, or shift it so the spot falls at one side of the reflector.



1 A tape recorder must run at the right speed. An rpm reading with the S&M kit tachometer showed speed variation due to worn drive parts. An accurately-fitted rubber puck on the tach can be adapted to read tape speed directly in inches per second.



2 To get best results with your lathe, read cutting speed in feet per minute. The tach will instantly give you accurate readings of any diameter. Cutting tool and drill manufacturers list the proper cutting speeds for all common materials.

Surplus Parts Make

Precision Tach a Bargain

Three ranges—0-500, 5000, and 15,000—cover the gamut of rpm's in the home workshop or laboratory, on machine tools, and in tuning kart engines

By BRICE WARD and BILL McHUGH

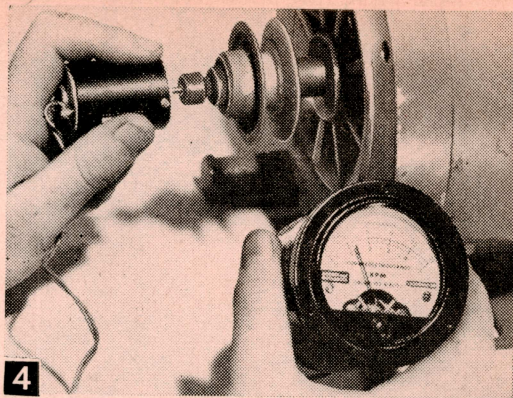
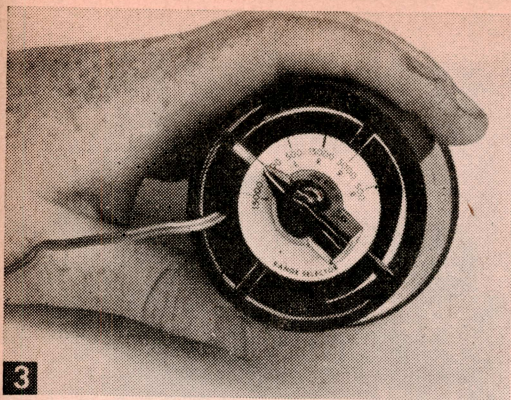
A GOOD hand tachometer belongs in the tool chest of every machinist, electrician, model maker, motor serviceman, and inventor. But a worthwhile tach on an experimenter's bench is rare, because it usually costs \$75 to \$150.

Following steps described herewith, you can build a precision tach using surplus parts offered in a \$16.95 kit made available by SCIENCE and MECHANICS. Original retail cost of the materials was about \$55, which can be shaded if you hunt for the various parts in the surplus marts. You'll save time and money, however, by ordering the kit which includes resistors of the right capacity for the motor supplied.

Principle of the electric tach is simple. Hook up a dc motor to a voltmeter and the motor will act as a generator when you turn it. Drive the motor by holding it directly on a revolving part as in Figs. 1 and 2, or against a belt (Fig. 11), and the voltage reading will be in direct proportion to rpm. By limiting the flow of current in the circuit, a variable resistor makes it convenient for you to set the meter to read directly in any speed range desired.

The tach requires a motor with such linear characteristics that if you plot voltage vs. speed on a graph, you'll get a reasonably straight line, as in Fig. 6.

The S&M kit includes the motor shown in



Left, a six-position rotary switch mounted on back of the case selects three speed ranges in either clockwise or counterclockwise rotation. Right, a pointed rubber puck is used on any shaft with center hole to read motor speeds under load. Flat rubber pucks will work well on plain shafts. Speed variations as well as rpm readings under load are symptoms to watch in servicing motorized equipment.

Fig. 1, which is a fine choice for a sturdy, portable instrument. Its original cost was over \$30 in factory quantities. It has a rating of 27.5 volts at .6 amps dc. At that power, the motor turns over at 15,000 rpm. Driven as a generator, the little motor robs very little horsepower, so you can use it to read high speed shafts of miniature lathes and grinders. The bearings have plenty of extra speed capacity, with tests indicating a minimum performance life of 250 hours at 24,000 rpm! This means a lifetime of tachometer performance, since you normally would use the in-

strument for tests, and not connect it permanently to a revolving mechanism.

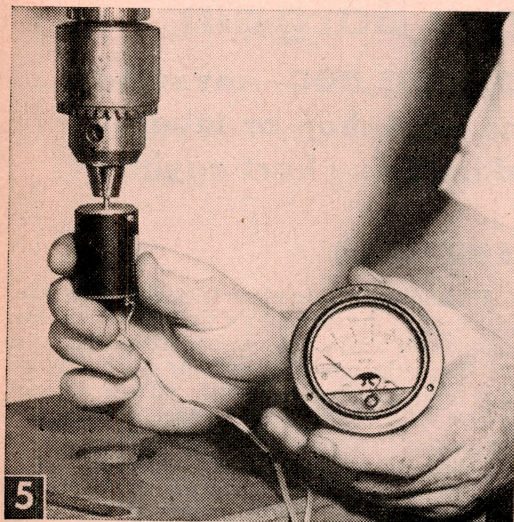
The meter itself, a standard 0-50 microammeter, was selected for its great sensitivity. You can mount it permanently in a metal meter box, but a plastic cup such as that supplied in the kit and shown in Figs. 3 and 4, makes a handy portable case. The meter has a special scale plate designed for direct readings of motor speeds in three ranges.

Assembly Steps. The hole in the large end of the case has been pre-cut for the meter, while the smaller end of the case has a $\frac{3}{8}$ -in. diameter hole for the rotary switch shaft. This range switch has a locking tab to prevent it from revolving in the case.

Remove the nut and washer from the switch shaft, then feed shaft through the $\frac{3}{8}$ -in. hole from the back. When locking tab touches the base, gently spin it around to scribe a light radius line on the case. At any point on this line, carefully drill a $\frac{3}{16}$ -in. hole from the outside. Too much pressure may chip the Bakelite. Drill a second $\frac{3}{16}$ -in. hole about $\frac{5}{16}$ in. from the outside rear edge of the case. Make sure that this hole, which is for the motor lead wire, will clear the case wall on the inside.

Turn the case upside down for use as a holder during assembly and soldering. Place switch so that the locking tab beneath faces away from you. Note that two vertical supports hold the switch wafer to the main switch plate.

Using long-nose pliers, gently bend all switch terminal tabs until they point straight out horizontally. Then feed a 2-in. length of bare wire through terminals 3, 2, 1, 12, 11, and 10. Strip $\frac{1}{2}$ in. of insulation from a 6-in. length of flexible lead wire and solder this end to terminal 10 as in Fig. 9. Solder connections at the other five terminals as in Figs. 7, 9, and 10.



The tach reads drilling speeds instantly. Either chuck the tach motor shaft directly or use a large cone shaped puck on the top end of the spindle. If you have a variable speed drill press, you may want to improvise a bracket to support the tach motor above the spindle.

Tie a knot 2 in. from the end of the two-conductor covered motor lead cable. Strip $\frac{1}{4}$ in. of insulation away from the end of each wire and solder to tabs 13 and 14. These are common feeds from the switch and are on the underside of the wafer (Fig. 10).

Installing the Resistors. Values of the resistors in the circuit will range widely (Fig. 7), according to the particular motor used. Since they are matched to the motor and the latter is not always the same, their exact values are omitted on the drawing.

Cut a 2½-in. length of hookup wire and strip $\frac{1}{4}$ in. from each end. Wire as a jumper across terminals 4 and 9, feeding wire around outside of the switch, but do not solder. Do the same with a 2-in. length of hookup wire across terminals 5 and 8. Cut a $\frac{3}{4}$ -in. piece of solid wire and connect terminals 6 and 7. Now you can solder the connections at tabs 7, 8, and 9 *only*.

Trim one lead wire of the highest-value resistor (R3) to $\frac{3}{4}$ in. and connect it to terminal 4. Do the same to the medium-value resistor (R2) and connect it to terminal 5. Repeat with the lowest-value resistor (R1) and connect to terminal 6.

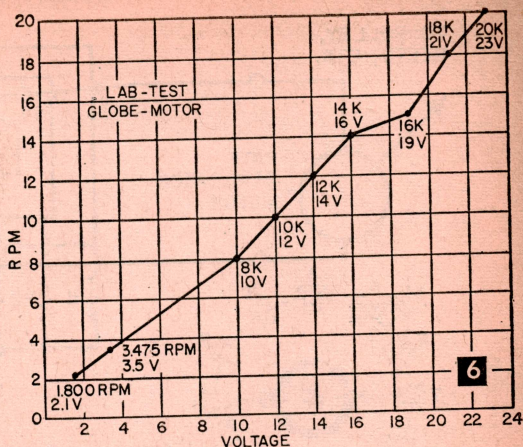
Now comes the important step of forming all three resistors close to the side of the switch. A snug fit is needed so that the assembly will drop into the case. After checking for this fit, solder the other ends of the three resistors to a 6-in. lead of flexible wire (Fig. 10). Solder remaining connections to complete wiring of the switch.

Setting the Range Selector. Carefully cut out the range selector dial, which is shown actual size in Fig. 8 as well as in the instruction sheet furnished with the kit. Now connect the two motor leads through the threaded Bakelite cover ring to the meter post lugs, and solder. Feed the motor lead cable through the hole in the back of the case. Turn switch clockwise all the way to read R (Right) 500. If your switch was supplied with a flatted shaft, temporarily place the pointer knob on the switch to locate proper position of the dial. Cement dial in place, cover with a lock washer, and tighten the nut on the switch.

Use *Duco* cement or any good plastic model cement to fasten meter to the cover ring. Solder motor leads to the two posts on the motor. If the dial indicates wrong direction, reverse connections to motor or meter.

Using Your Tach. If the wiring is correct, you should get a meter deflection on the 500 rpm ranges, right and left, by twirling the motor shaft between the fingers. Remove the nut and gear from the shaft and thread on one of the cone-shaped rubber pucks supplied with the kit.

To read the speed of a rotating motor shaft, *always* start by setting the range switch on the highest (15,000) rpm range in the proper



Typical graph of motor speed vs. voltage showing straight line characteristic required for accurate tach.

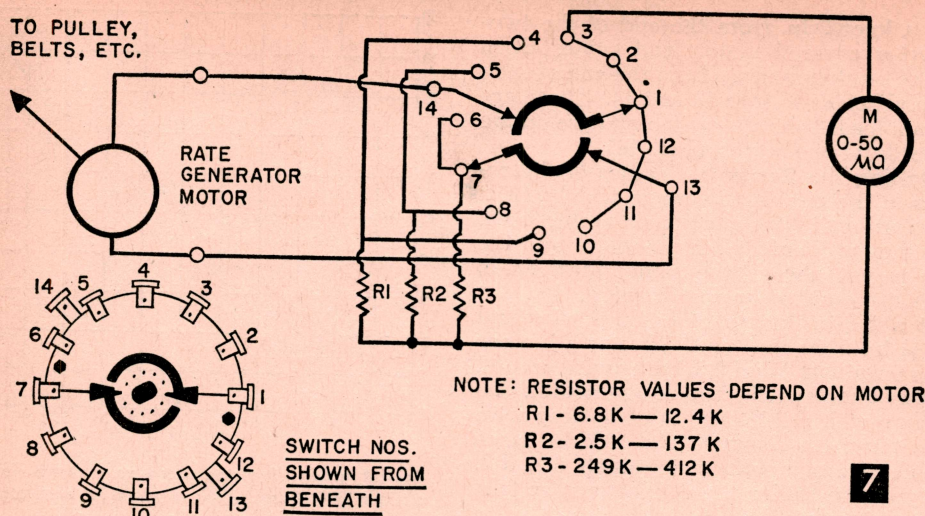
direction of rotation: R (clockwise) or L (counterclockwise) as you face the shaft.

Most motors have shafts with a center-drilled recess on the end. Lightly press the rubber puck into this recess to take the reading as in Fig. 4. With a little practice, you'll soon be able to hold the pointed tip correctly against most moving shafts. The trick is to hold the motor lightly and allow it to center itself against the revolving part.

Special Purpose Pucks are easy to make, using the small rubber stoppers obtainable in many drug stores and chemical supply houses. Natural rubber stoppers of no more than $\frac{5}{8}$ -in. diameter are the best. To mount the puck on your tach motor, drill a $\frac{1}{16}$ -in. hole through the stopper and then thread the stopper on the shaft.

Because it is difficult to drill a true center hole in rubber, the puck may not be perfectly balanced. Here's an easy way to true up the puck. Disconnect the motor lead wires from the instrument. Protect the motor bearing by covering the end plate with a piece of oiled

Cut out dial on reverse side



Wiring diagram.

felt cut from a discarded hat, or simply apply cellulose tape around the shaft. Then drive the motor with any source of low voltage dc power such as a 12-volt storage battery or a model train power supply. Hold the puck up against a piece of coarse sandpaper and use light pressure to form the shape desired.

Flat-shaped pucks with the ends sanded slightly concave will be useful on shafts that are not center drilled. Short lengths of rubber tubing can be used to couple the tach shaft to various small motors, such as model engines. If you want to read lathe, drill press, or shaper speeds, you'll find that a small, tapered rubber stopper will fit the top of a spindle or right in the head stock bore, as in Fig. 5.

If you are working with small shafts of less than $\frac{3}{8}$ -in. diameter, write to the Merkle-Korff Gear Co., 213 N. Morgan St., Chicago 7, Ill., for a catalog describing its rubber flex couplings. A set of these in various sizes

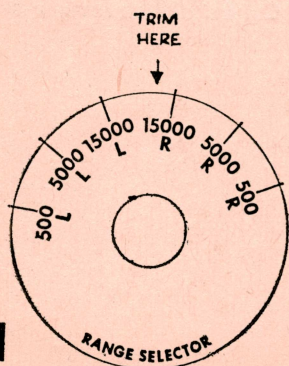
makes possible instant connection to a wide variety of shafts. For slow rpm, check electronics catalogs for couplings.

The motor shaft comes fitted with a gear held very firmly in place by a lock nut. To remove the gear, slip a small, hardened punch or an old drill point through the hole in the motor shaft to keep it from turning while you are loosening the lock nut. Turn the nut in the normal direction—counterclockwise as you face the shaft. A drop of penetrating oil on the nut will help loosen it. The gear fits over a taper on the shaft. You can pry it off gently with a lever bar or a piece of hardwood. Major diameter of the motor shaft after the taper is $\frac{1}{8}$ in.

The motor is prelubricated and, when shipped, has never been used except for a two-minute lab test. Bearings should require no lubrication for at least 50 hours of use; then lubricate them with a tiny drop of very light machine oil. Too much oil may foul the brushes.

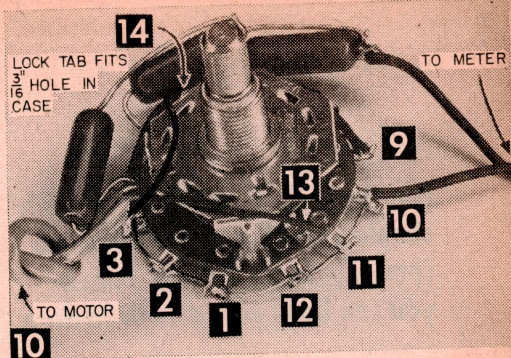
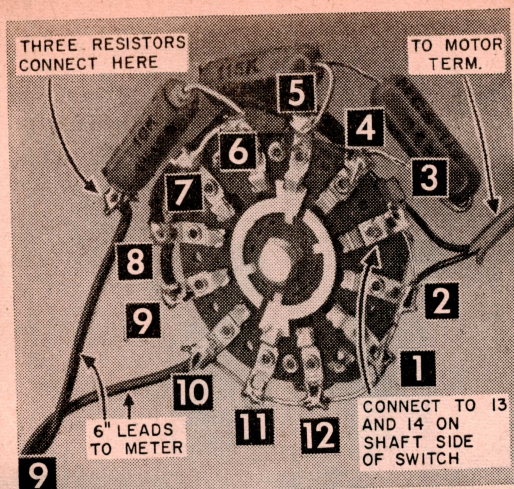
Reading Surface Speeds. To read directly in inches-per-minute, you will need a micrometer to turn down a puck to .315-in. diameter, or slightly over $\frac{1}{16}$ -in. (.312). A puck with this diameter will indicate linear speed on the meter when in contact with any moving belt or disk. For a feet-per-minute reading, you will need to machine a fitting for the tachometer shaft which will mount an aluminum disk of about $3\frac{1}{4}$ -in. diameter and $\frac{1}{16}$ in. thick. Cement a piece of $\frac{1}{8}$ -in. or $\frac{3}{16}$ -in. sheet gum rubber to the disk and turn it until the circumference is exactly 1 ft. The diameter will then be 3.821 in., or slightly more than $3\frac{13}{16}$ in.

While contact wheels of exact nominal diameter give you convenient dial reading in inches or feet per minute, you can use any



8

Actual size of dial for range selector.



Closeup views showing how six-position switch is wired to give you three speed ranges in forward and reverse rotations. All connections are on face of switch (left) except the common switch feeds at tabs 13 and 14 on underside of wafer (right).

diameter rubber wheel almost as easily. Electronic supply houses offer a variety of rubber wheels as replacement parts for rubber drives of tape recorders and record players.

To measure the working circumference of such a disk, mount it on the tach motor, mark it at one point, and roll it along a steel measuring tape fastened flat to a bench. Count the number of turns over a distance of 6 to 8 ft. Measure to an exact spot and divide the length traveled by the number of turns to get the exact circumference. This will be a simple conversion if you are handy with a slide rule or can prepare a graph.

Other Lab Uses. During S&M test procedures, two of the motors were run for many hours while coupled together, one as a driver

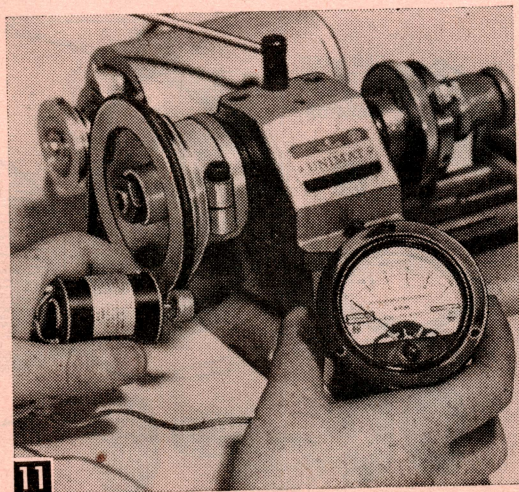
and the other as a tach generator. With a well-regulated dc power supply, there was practically no fluctuation or hunting in speed from about 600 to 20,000 rpm. Thus, the motor could be coupled to lightweight disks for timing and pulsing applications for photocells. Without load, the motor will run down to about 200 rpm.

Since the motor bearings have a runout in micro-inches, this tach can also serve as an ultra-precise miniature grinder. There is no end play in the bearings.

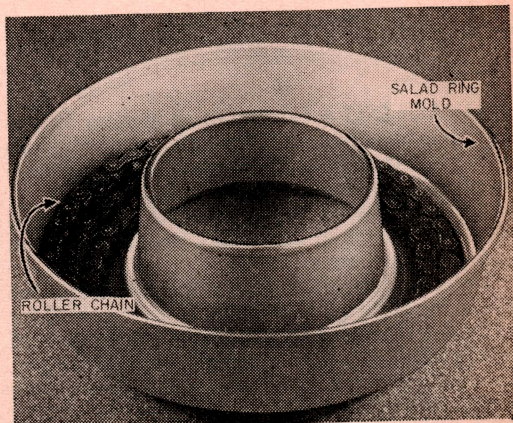
Coupled to a lightweight fan blade the tach will make an efficient wind velocity indicator.

Roller Chain Cleaner

- There's no better way to store or clean a bicycle or kart chain than completely immersed in solvent. The problem is to get a container that is the right size, yet will not



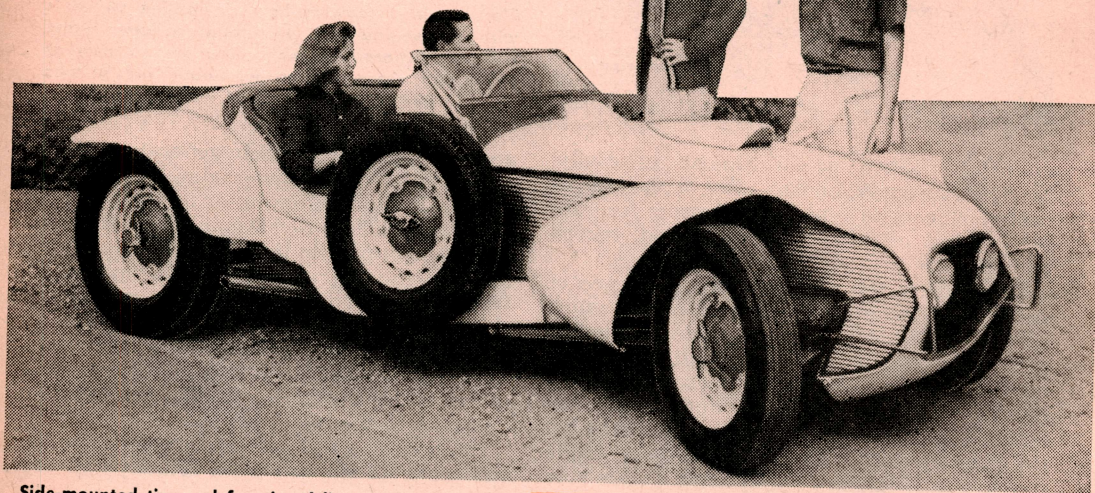
Checking belt speeds on a lathe is easily done by reading with the side of the motor puck pressed against the moving part.



require excessive amounts of solvent to do the job. One answer is to use a ring mold such as is used to mold salads. The chain is easily looped around the center of the mold without danger of kinking, and a pint of solvent will completely cover it.

Wild Hare Sports Car

For less than \$300 and with simple cutting and welding—no specially formed body panels—you can build your own *Wild Hare*



Side-mounted tire and functional lines give classic, yet modern appearance everyone admires.

By **JOE McBRIDE**

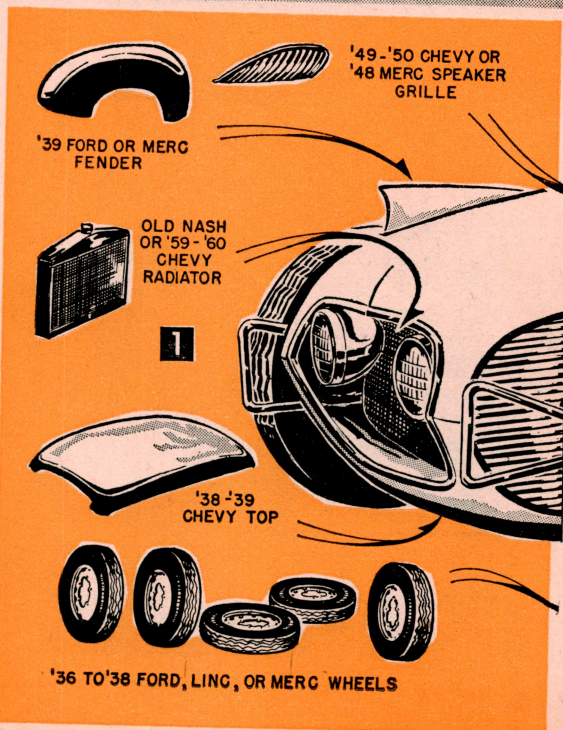
Photos by **JOEL DARDIS**

RIVALLING a European sports car in appearance but built from junk-yard "goodies," the Wild Hare has that ageless—hard to date—look of the classic car.

Simplicity—the keynote of all good design—is the secret of its smart appearance and ease of construction.

Rigid specifications and dimensions are not given, as styling ideas will differ from builder to builder according to individual tastes and availability of parts. Here is a chance for you to exercise your own judgment and creative skills, with this design as a guide, in building your version.

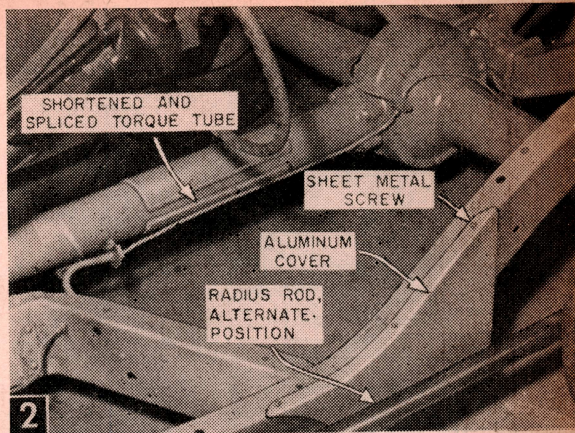
Your First Step in building your own Wild Hare is to locate a chassis. You can use any Ford or Merc made from 1939 to 1948. The condition of the body is unimportant, but avoid a car with such faults as "torn-up"



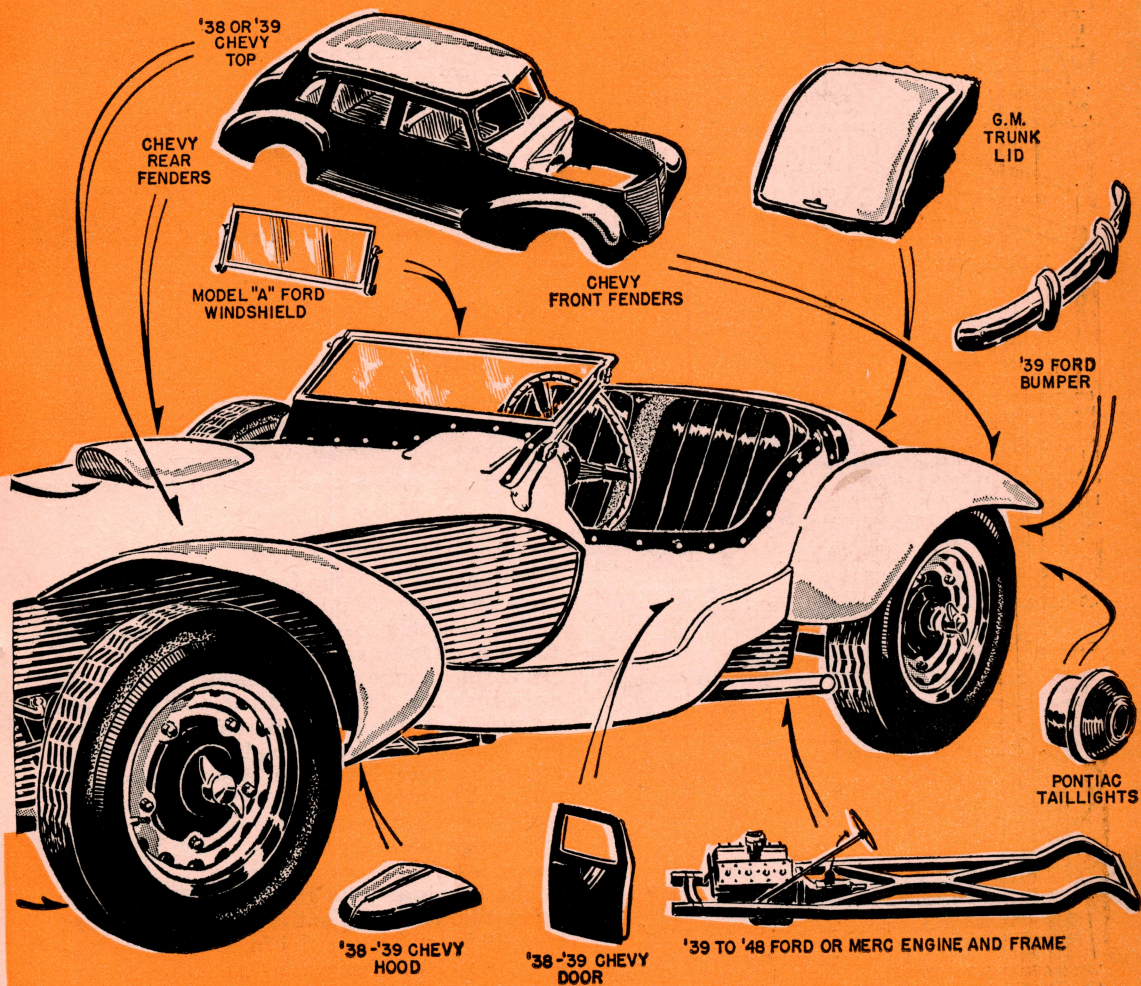
chassis, bad brakes, or worn-out steering linkage. If you can find one with a hot engine you're off to a flying start.

Other cars could of course be the basis for a sports car conversion, and you can use the idea and techniques outlined here to guide you in whomping up your own car. The sky is the limit—but remember: keep it simple to avoid a hashed-up look.

Cut the frame to a wheelbase of 100 in. This will accommodate a 6-in.-thick back cushion and a 6-ft. driver. But if a thin bucket-type seat is used and if you do not change the engine position, the wheelbase can be decreased to 90 in. "Step" the frame at a point 71 in. back from the center of the top front rivet in the front cross-member (Point A in Fig. 3). Make the step 8 in. wide and kick up the rear end of the frame enough to bring the low point of the frame, under the step, 7 in. off the ground. Where it passes



Alternate method of splicing the frame without step. Welds and end of frame rail are covered with thin aluminum, for appearance's sake. Note torque tube splice, and repositioned radius rod.



Know what your "P Q" is? That's your Popularity Quotient—and the Wild Hare won't hurt it a bit.

changes, and a second version of the Hare in which the engine was not moved. If you want your car only for street use, you can follow this latter version, and if you use a 2-in. dropped front axle, in place of a stock axle, the car will be just as low.

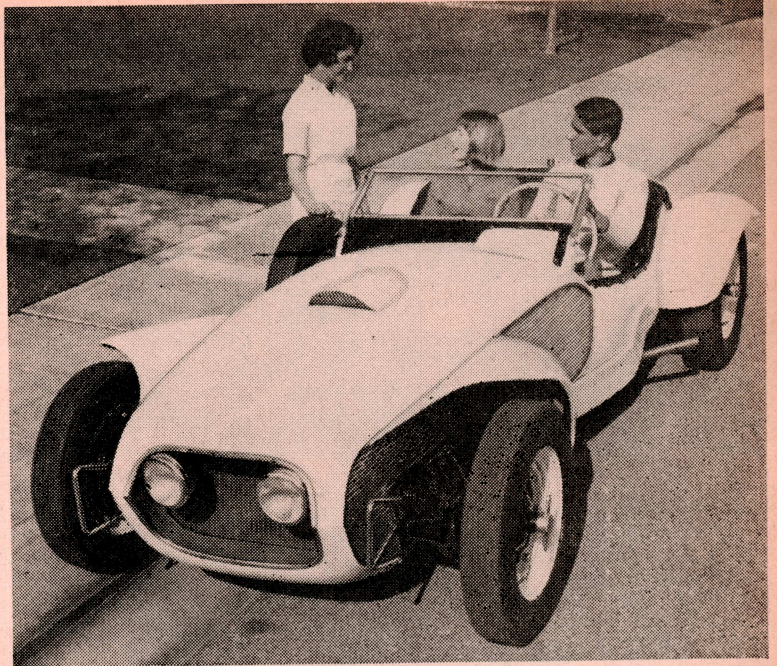
If the original engine mounting is used, the Ford wishbone will be undisturbed, but if the engine is moved back, the wishbone arms can be bent at the front ends, then attached at the rear ends to the undersides of the frame side rails with ball-joint rod ends (Figs. 10 and 12).

A '49-'53 Mercury engine which bolts directly to '48 and older Ford transmissions can be easily installed by making the following changes: Replace the Mercury water pump with '49-'51 Ford truck pumps which have the same mounting pad as the older Fords. Knock off the spacer sleeve on the front of the Mercury crankshaft, and replace it with a '39-'40 Ford or Mercury sleeve and flange that mounted the fan on the crankshaft. No machining is necessary but the fan pulley will have to be cut loose and re-welded to line up with the water pump pulleys. A crankshaft mounted fan is ideal for a low nosed roadster.

The Small Exhaust Manifold on the left side of the Mercury engine (Fig. 8) can be replaced with a large manifold from the right side by cutting the ears off the center flange and re-welding them to line up with the exhaust outlet in the block. This will give you exhaust capacity equivalent to a set of headers at very low cost.

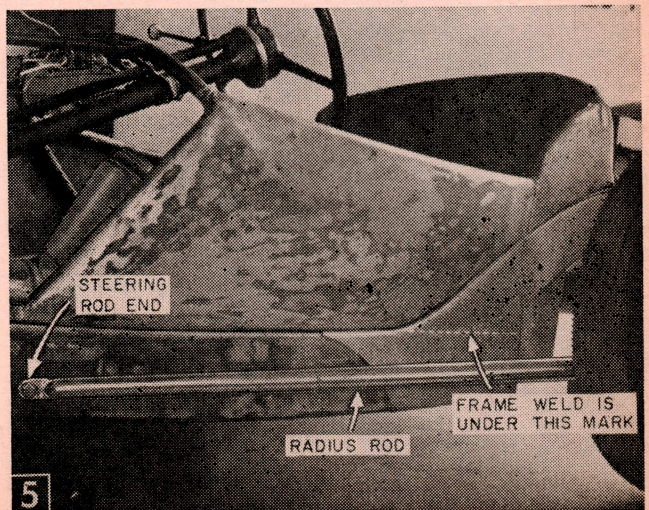
With the rear axle in its final position and the transmission in place, you can determine how much to cut off the torque tube

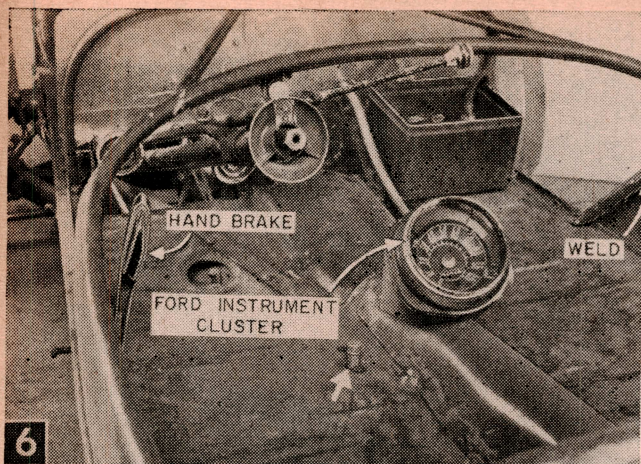
The covered frame splice is shown here, and the alternate radius rod position, in which the rod is bent to lie along the frame and secured at its front end at a point opposite the universal joint in the propeller shaft.



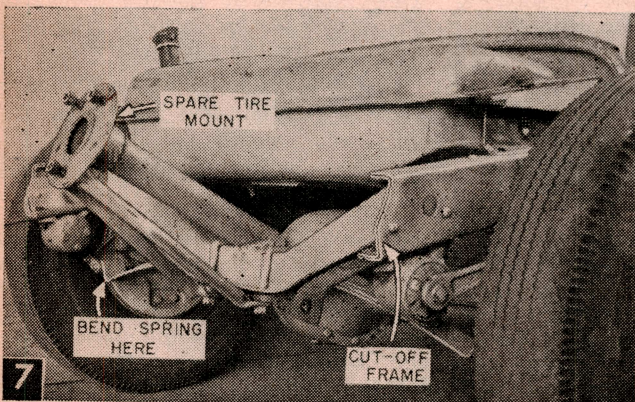
and propeller shaft. Splice the tube back together with part of the cut-out portion as reinforcement (Fig. 2). Cut the desired amount off the rear end of the propeller shaft, machine it to a press fit in the splined coupling, and drill the pin holes in the coupling to $\frac{1}{2}$ in. Press coupling on the shaft and weld through the holes (Fig. 3). Shorten the radius rods, bend them in, and bolt them to a lug welded to the underside of the torque tube 10 in. ahead of its rear bolting flange (Fig. 3).

The wheels shown in the photographs are the large hub type used from 1936 to 1939 on Ford, Lincoln, and Mercury. For street use,

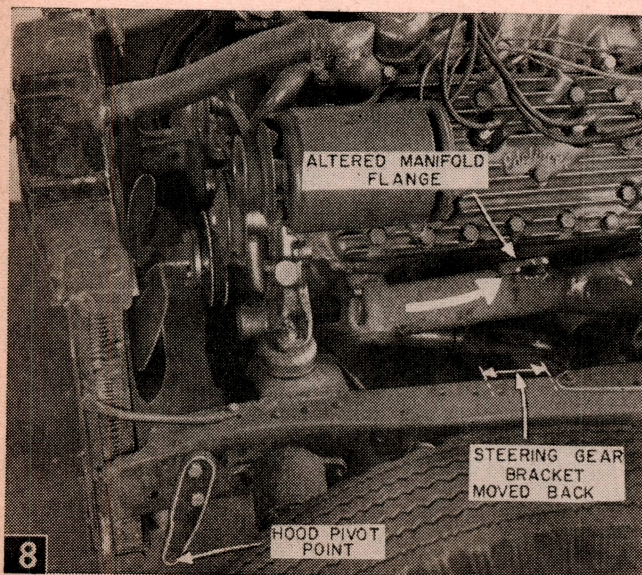




Optional center mounted instrument panel. A '49-'50 instrument panel may be used as it has the same type senders as the older Ford and Mercury engines. The hand brake is mounted on the left and the battery box is on the right directly behind the firewall. Arrow points to the headlight dimmer switch, now hand operated. Either column or stick shift may be used. Also visible at right is the tack-welded body metal, wrapped around the pipe frame.



Optional spare wheel mounting. A piece of 2" pipe is welded inside a rear wheel hub and welded to the rear cross member. It is further reinforced by a piece of 1" tubing bolted to the wheel hub and the spring U bolts. Main leaf of spring is bent to achieve proper frame height.



mount the same size tires all around, but for really hot driving you can fit a larger size, or racing slicks, on the rear.

Make the Hub Caps out of 2-in. pipe caps with welded on lugs (Fig. 3). Make two rights, two lefts, and one extra for the spare. Braze the front ones to the grease caps, and screw the rear one to short lengths of 2-in. pipe welded to the wheel hubs.

Use a radiator not over 21 in. or 22 in. high, and about 29 in. wide (including the brackets), set in between the frame rails (Figs. 1, 8, and 9). Arrange water hose connections to suit your engine, and don't forget a drain valve in the bottom. You will need a fan for driving in traffic, and if the engine has been repositioned, you will have to remount the fan on the crankshaft, using a shortened fan extension (Fig. 9) to clear the steering linkage. You will also need a "crab" type distributor. Fit a metal shroud between the fan and the radiator to improve flow of the cooling air. To keep the hood line low, attach a Stromberg WW carburetor (used on Stude sport coupes from '53 on) to a Mercury 4-bolt intake manifold ('49-'53), and notch the generator mount so the generator will tip to

The generator is mounted low on the left side to keep the hood line low. Chalk mark on top of frame shows the original position of the steering gear bracket. The hood mounting bracket is directly behind the radiator and in front of the shock absorbers. It is recommended that the original Houdaille shocks be retained as they can be adjusted to suit the light weight of the roadster. The above procedure also applies if you move the engine 10 in. to the rear, except you do not have to change the water pumps.

the right side (Fig 12). Then measure around the generator and water pump pulleys to determine V-belt length.

Relocating the Engine will also necessitate bending the clutch and brake pedals for better foot contact, and remounting the master cylinder bracket on the frame X-member. Locate the hand brake on the torque tube tunnel, or on the left frame rail, convenient to the driver.

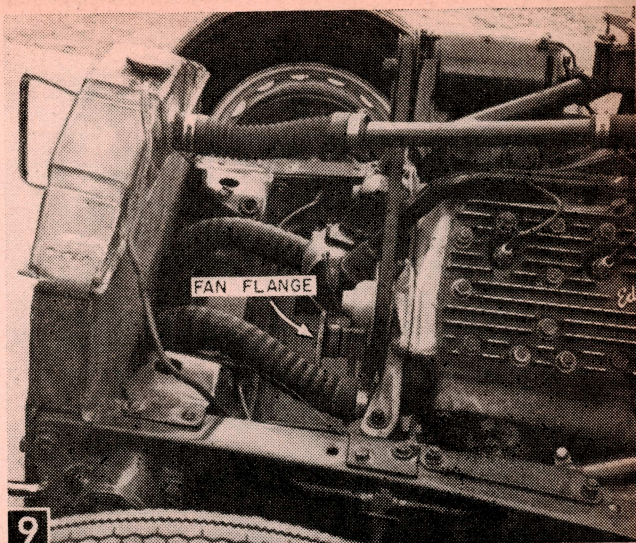
Move the filler spout on the gas tank from the side to the middle. *Caution: Do not bring a lighted torch near an empty gas tank until the tank has been thoroughly flushed or steamed out. Take no chances on this.* Use a 4-in. pipe cap with a regular gas cap brazed inside for the new gas tank cap. Make the body frame of $\frac{1}{2}$ -in. black iron pipe, welded. You can beef up the roll bar (the top back member of the body frame) as much as you like by making it of heavier material—for instance 1-in. dia. x $\frac{1}{8}$ -in. wall steel tubing. Get both sides of the frame alike by making a cardboard template with a smooth, fair curve marked on it to guide you in making the bends in the top rail.

Make the fire wall frame of 1 x 1 x $\frac{1}{8}$ -in. angle iron, covered with 24 gage galvanized sheet iron secured with #6 x $\frac{3}{8}$ -in. binding sheet sheet metal screws. This frame is contoured to fit the curve of the hood and is 17 in. above the frame rails.

Two Instrument Panel locations are shown (Figs. 6 and 10). If a narrow panel such as a '46 Ford panel or a floor-mounted panel is used, body work will be simplified.

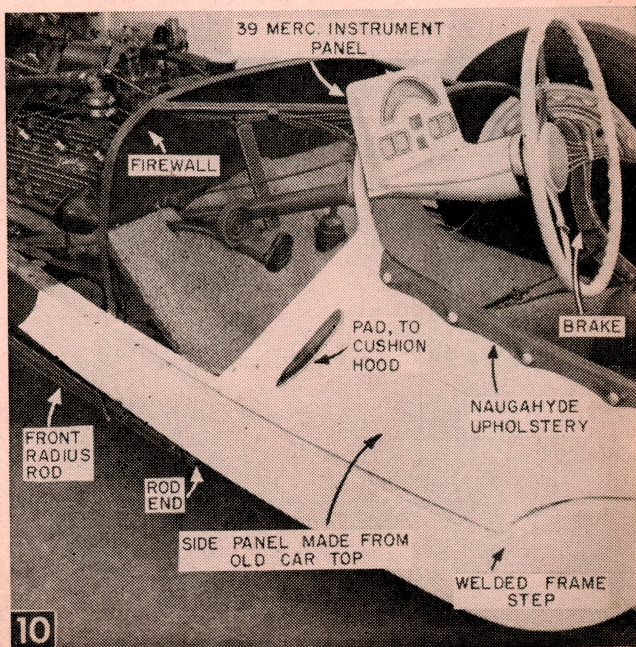
Cover the sides of the body (Fig. 5) with metal taken from a car door or top. This metal has a slight compound curvature that

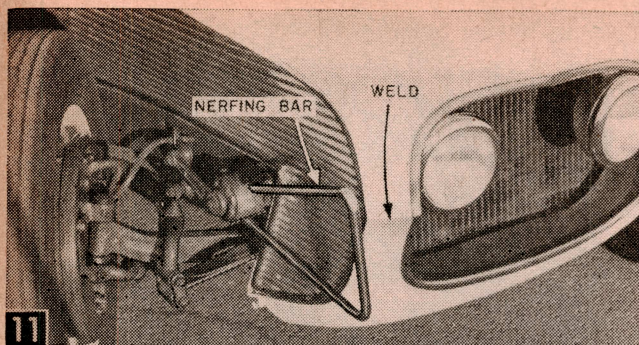
In this version of the Hare, a '39 Mercury instrument panel was notched and bent about 15 degrees forward from its original vertical position. The horn button, starter button, and headlight switch are mounted on the lower side of the shroud. A flexible Ford ('36-'38) steering wheel was used, the throttle pedal was inverted and the stock hand brake mounted on the torque tube tunnel. The floor-stick shift was bent down to clear the body cross-member and the brake and clutch pedals were bent down for better foot contact.



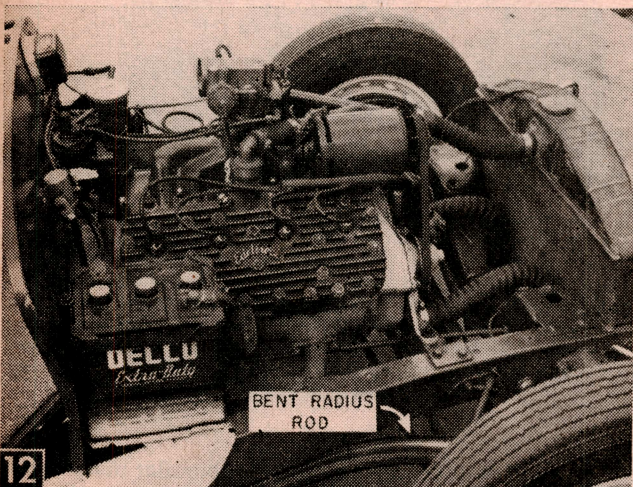
View showing how in one version of the Hare, the engine was moved back 10 in. from its original mounting directly behind the radiator and lowered 4 in.—producing better handling characteristics. By using a Ford "crab" type distributor (no coil) a fan can be mounted on the crankshaft flange behind the axle and a fan shroud installed for slow city driving. Note the position of the steering gear bracket and how the hydraulic brake lines are run through the frame rather than on top of the frame where they would interfere with the hood.

will be more attractive than flat metal would be. Make the turtle-back from any General Motors '46 to '53 trunk lid (except fast-backs), with slightly turned down sides. The

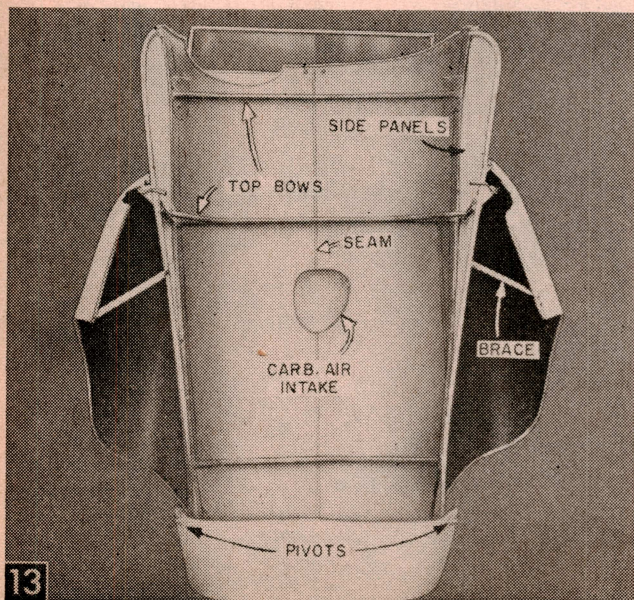




View showing how windshield posts of the two tops were matched and welded. The radiator opening is trimmed with stainless steel windshield molding, and the inside is lined with light gauge aluminum. Headlights (tractor or fog-light type) are supported by the flange around the opening. Nerfing bars are held by the shock absorber bolts.



General view of the engine compartment. Note how the radius rod is bent to parallel the frame rail. Ball joints from steering linkage are welded to the ends of the radius rods and bolted to the bottom flange of the frame rails. There is room enough in the engine compartment for any modern OHV V8.



inner lining of these lids is adequate framing—simply bolt at the edges to the side rails.

You will have to make a deeper tunnel in the floor pan (Fig. 14), to clear the torque tube in the new dropped-seat position. Weld this, and a flat seat back made from a door panel, to the modified floor pan, then secure the new pan in position in the frame by tack-welding. Make the seat cushions of 6-in. foam rubber mounted on ½-in. plywood. Back cushions taken from practically any car can be cut down and re-welded to fit, or you can use bucket seats.

The Front Part of the body—hood, windshield, and fenders—is all one unit (Figs. 4 and 13). You will need two old car tops and some other body parts (from the '37-'38 Chevy) to make it. Make two side panel frames of ½ x ½ x ⅛-in. angle iron, and cover them with .035-in. aluminum sheet, corrugated ⅝ in. The aluminum is applied after the top of the hood is attached and is fastened with #6 x ⅜-in. sheet metal screws covered with #4868 Jarrow Products door seal, available at refrigeration supply stores. These frames must be alike, of course, and their shape must blend with the contours of the finished car. Lay them out full size first on stiff cardboard and support them in position on the chassis with light wooden slats. Then cut the upper part of the hood out of one of the car tops by cutting a strip out of the center and bringing the two sides together, joining them down the center with a standing seam. This seam tends to take the curvature out of the panels—to restore it, crimp the seam flanged with a pair of pliers

Underneath view of the hood (which covers 55% of the body) shows center seam bracing, and other details of the hood construction. Fenders are secured to the hood with bolts and sheet metal screws.

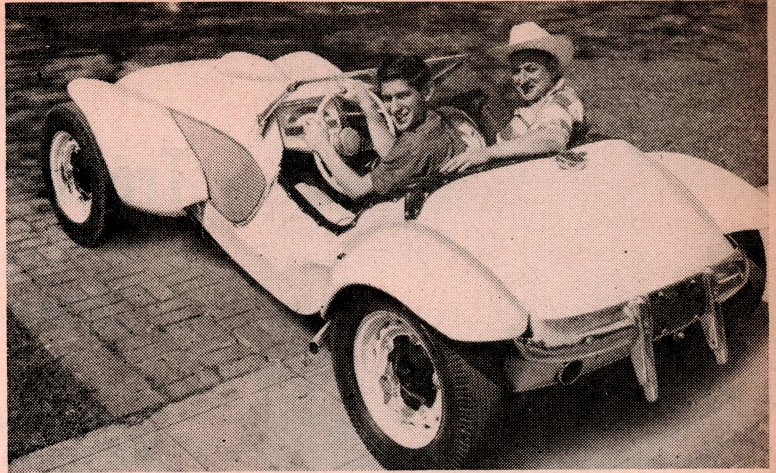
fied as in Fig. 3. If the seam is to be welded together, use electric arc welding to avoid heat buckling. It is probably better for an inexperienced welder to bolt or rivet the seam together and cover it with a chrome strip, such as Chrysler fender welt. Weld three top bows inside the hood (Fig. 13) to stiffen it. Make the lower front part of the hood from part of the second car top, matching and carefully welding the windshield posts together.

Pivot the Hood on two horns (Fig. 8), locating the pivot point 1 in. ahead of, and 10 in. below, point A. Use two $\frac{3}{8}$ -in. bolts, passing through $\frac{3}{8}$ -in. pipe bushings, welded to the hood, for the pivots.

Make the carburetor air scoop from parts of two fenders ('40 Ford or others) cut to size and welded down the center. A '48 Merc or '49 Chevy speaker grille will do for the air scoop grille.

Use '39 Ford or Merc front fenders cut down and reshaped to fit the contour of the hood, with added parts (Fig. 1) from a '38 Chevy hood for the front fenders, and front fenders from the same old Chevy ('37-'38) for the rear fenders. Re-roll the edges where they are trimmed.

No Front Bumper is used. Instead, nerfing bars (Fig. 3) made from $\frac{5}{8}$ -in. tool steel, and secured to the frame by the front shock ab-



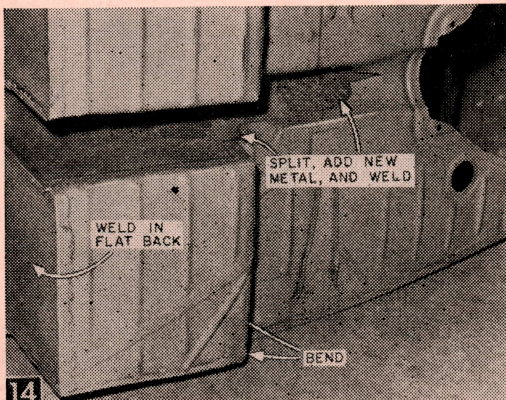
Although fabricated from ready-made used car parts the Wild Hare has a professional look from any angle. The front and rear fenders are stock, cut down and the edges rolled. The turtle back is made from a passenger car trunk lid. It has a 100-in. wheelbase and weighs 2050 lbs. ready to roll.

sorber bolts, do the trick. These, along with the wheel nuts, windshield frame, hub caps, and gas cap, are chromed, and are practically the only chrome on the car.

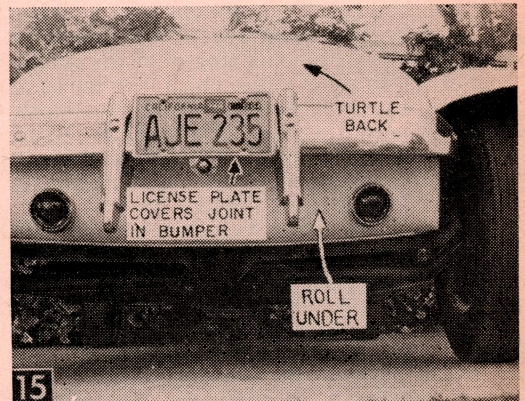
The rear bumper is a '49 Ford bumper, shortened, with the welded joint in the center covered by the license plate. The roll-under (Fig. 15) is made from a piece of car top, and the joint between it and the turtle back is hidden by the bumper.

You can use either a rear or side mount for the spare tire (Fig. 7). Use part of a rear wheel hub for the center of the mount.

Cover the visible parts of the floor pan with floor mat material, reupholster the seats and car interior to suit your taste, paint the car with your favorite colors, well rubbed out, and you are ready for action.



Underneath view of the modified floor pan shows the double bend which drops the seats between the frame rails, and the deep tunnel required to clear the torque tube.



Neat roll-under effect is made from a piece of old car top fitted to edge of turtle back (a GM trunk lid). Shortened Ford bumper covers the joining. Combination stop-and-tail lights are Pontiac.



1 Determining leakage current at various collector voltages. Transistor under test is in socket at right of large meter.

HERE'S a valuable addition for the experimenter's lab which will perform more transistor checks than any commercial unit we have yet seen in the under-\$100 class. You can build it for \$30 to \$65, depending on how you buy the parts.

Most economy-priced transistor testers indicate only the overall current gain, with a fixed input signal at a fixed supply voltage. The checker in Figs. 1 and 2 will, in addition, measure actual dc leakage current, net current gain and ac voltage gain at low inputs.

If you live in a metropolitan area, you can buy nearly everything except the two audio transformers in surplus stores for an overall cost of \$30 to \$35. Value of all new parts, as listed in the mail order catalogs, is slightly under \$65—still a substantial saving. Using surplus meters, as I did, will reduce the cost about \$14. Substituting 5% resistors for 1% resistors could cut out another \$5.

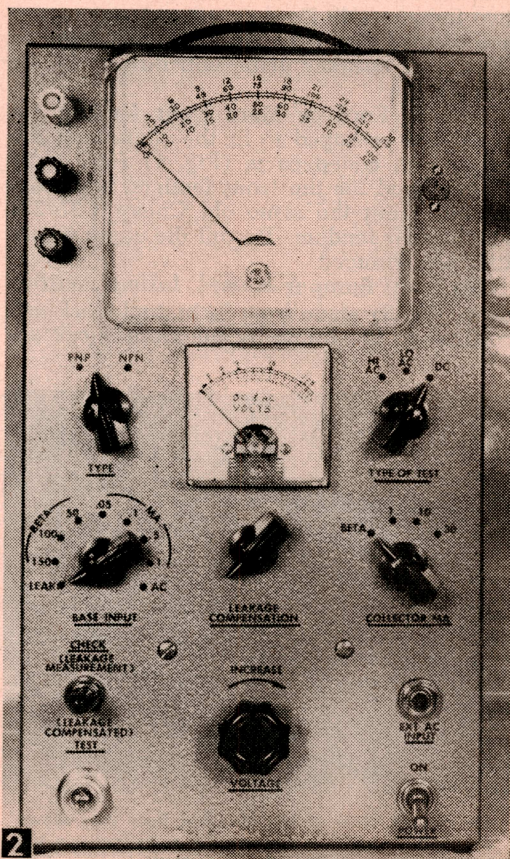
This checker makes dc measurements with both a varying signal input and a variable supply voltage; checks ac measurements only with a variable supply voltage. All these tests are made under the generally used common emitter circuit. In this circuit, the signal is placed between the base and emitter, and the output taken from between the collector and emitter as in Fig. 3A. Current gain, or beta, is the ratio of the input and output currents. All schematics in Figs. 3 and 8 show polarities for PNP transistors, but the unit

Deluxe Transistor Tester

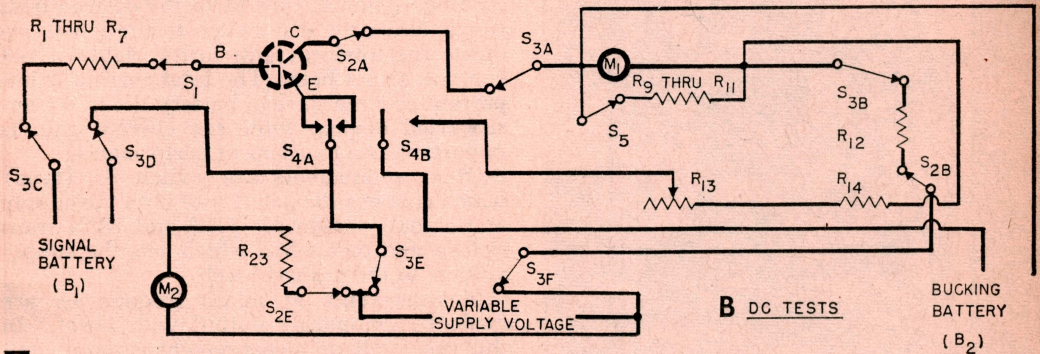
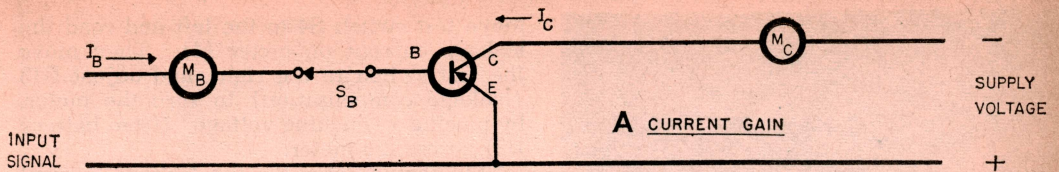
for an
Economy Price

Versatile checker provides complete flexibility in both input and collector voltage tests, plus ac measurements

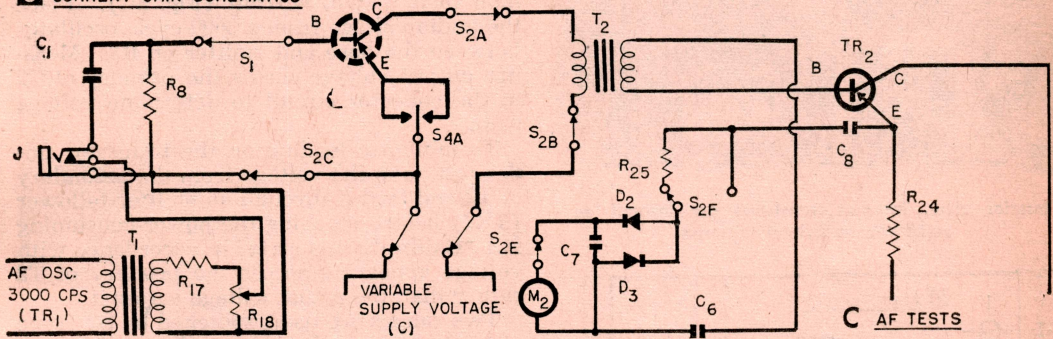
By W. F. GEPHART



2 Panel view.



3 CURRENT GAIN SCHEMATICS



also reverses polarity, so that both PNP and NPN transistors can be tested.

All transistors have some leakage, which is collector-emitter current, that flows even without any signal current flow in the base-emitter circuit. If switch S_B in Fig. 3A were opened, this leakage current would be read on meter M_C . Net current gain for the transistor would then be the ratio of the difference (total current minus leakage current) in collector current to the input (or base) current.

Figure 3B shows how dc tests are made with this unit. The base (or signal) current, set by one of several resistors (R_1 through R_7), flows from the signal battery (B_1) through base and emitter. Collector current flows from the variable supply voltage through M_1 and from collector to emitter. If the base current is known, the current gain can be determined by reading meter M_1 .

In the complete circuit, there are a number of refinements. Since B_1 is a mercury-type signal battery with voltage reasonably constant throughout its life, definite signal voltages can be set up without a monitoring meter. Resistors R_1 through R_7 provide fixed

input currents from 10 micro-amps to 1 milli-amp. Meter M_2 has several shunts, giving it full-scale deflection from 1 to 30 ma; and resistor R_{14} provides a reasonable load for the transistor under test.

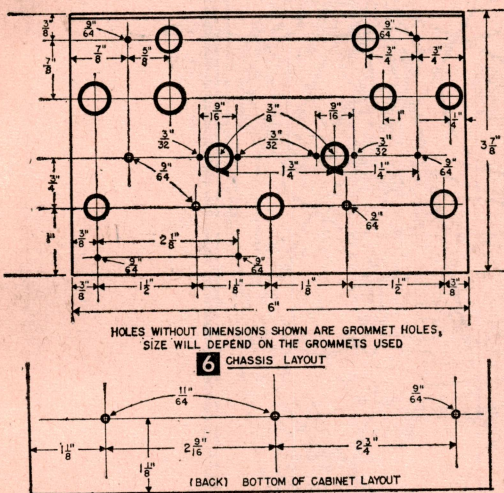
For Measuring Current Gain, the meter reads 1.5 ma full scale (in beta position of S_5), and there are three current inputs. For transistors with high gains, the input current is 10 micro-amps, and the meter is calibrated 0-150 (10 micro-amps times a current gain of 150 equals 1.5 ma). For medium gain units (betas of 0-100), the input signal is 15 micro-amps and the meter is calibrated from 0-100. For low gain units, the input signal is 30 micro-amps and the meter is calibrated from 0-50.

All of these inputs can be classified as low signal inputs and will indicate gains in line with manufacturers' specifications. The input signals and meter M_2 range can be further increased (S_1 and S_5) to measure current gains at large input signals.

These measurements include leakage currents which can be checked and offset for testing the net current gain. Disconnect the base by setting S_1 (base input) on "leakage,"

MATERIALS LIST—TRANSISTOR CHECKER

Desig.	Description	Desig.	Description	Desig.	Description
R1	4K 1% resistor	R17	82K 1/2-watt resistor	T1	driver transformer (Triad A-81X)
R2	8K 1% (4K + 4K) resistor	R18	10K potentiometer	T2	26 volt filament transformer (Merit P-2962)
R3	40K 1% resistor	R19	100 ohms 1-watt WW resistor	T3	modulation transformer 10K primary 1:1 turns ratio (Merit A-3007)
R4	80K 1% (40K + 40K resistor	R20	400-ohm 4-watt potentiometer	TR1	2N107 transistor
R5	135K 1% (120K + 15K) resistor	R21, R22	820-ohm 1/2-watt resistor	TR2	2N308 transistor
R6	270K 1% resistor	R23	25K 1% resistor	J	closed circuit jack
R7	400K 1% resistor	R24	470-ohm 1/2-watt resistor	M1	4" 0-1 ma meter
R8	5K 1/2-watt resistor	R25	1500-ohm 1% resistor	M2	2" 0-1 ma meter
R9	100-ohm 1% resistor	D1	1N536 Silicon rectifier	NE	NE-51 bulb and holder
R10	5.55-ohm 1% resistor	D2, D3	1N34, 1N6	C1	.1 mfd. 200-volt capacitor
R11	1.72-ohm 1% resistor	S1	1-pole, 9-position rotary switch (Mallory 32112J)	C2	500 mmfd. capacitor
R12	1K 1-watt resistor	S2, S3	6-pole, 3-position rotary switch (Mallory 3263J)	C3	.005 mfd. 200-volt capacitor
R13	25K potentiometer	S4	DPDT spring-return lever switch (Switchcraft 3037)	C4, C5	100 mfd. 50-volt capacitor
R14	2K 1/2-watt resistor	S5	1-pole, 4-position rotary switch (Mallory 3215J)	C6, C8	10 mfd. 25-volt capacitor
R15	.27 meg. 1/2-watt resistor	S6	DPST toggle switch	C7	25 mfd. 25-volt capacitor
R16	.1 meg. 1/2-watt (Not required if neon bulb socket includes dropping resistor; use only if standard bayonet base socket is used.)				
Misc.	4x7x12" Minibox (Bud CU-2111A), 3 transistor sockets (Elco 3309), 6 knobs, 3 binding posts, tie points, rubber feet, hardware				



scale is used for reading the 0-1 ma and 0-10 ma ranges. Shunts for this meter (R9, R10, and R11) and the multipliers for meter M2 (R23 and R24) are based on 0-1 ma movements with internal resistances of 50 ohms.

After wiring is completed, R18 must be set and the scales on meter M2 calibrated. Both operations require use of an ac-dc vacuum-tube voltmeter.

To set R18, connect the VTVM across R8, turn the unit on, and adjust R18 until the meter reads .1 volt ac. A test transistor need not be in the test socket at this time, but switch S2 must be on one of the ac positions.

To calibrate the dc scales on meter M2, connect the VTVM between the bottom side and arm of R20, set S2 on "DC," and mark the points on the M2 scale where the VTVM reads 1.5, 3, 6, 9, 15, and 22½ volts dc.

Calibrating the ac scales is somewhat more difficult, and requires either an audio oscillator or high gain test transistor, such as a 2N138 or 2N265.

If an audio oscillator is available, set it for 3000 cycles and connect it and the VTVM across the primary of T2. Turn the transistor tester "off," but set S2 (type of test) on "LO AC." Gradually increase the output of the audio oscillator, marking reference points for various voltages (as read on the VTVM) on the meter M2 scale. When full-scale deflection is reached, switch S2 to "HI AC," and make a second set of marks for the second scale.

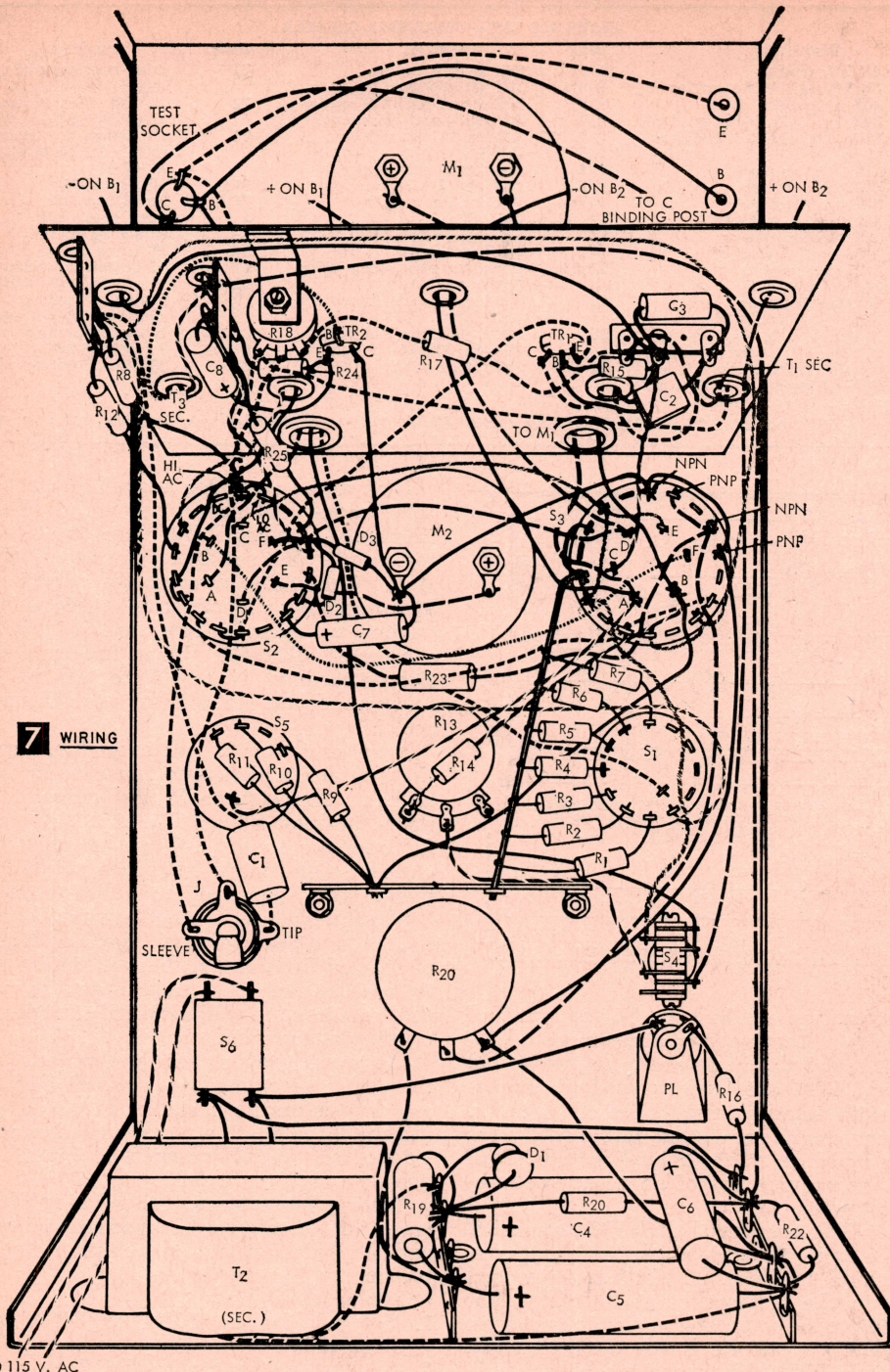
If an oscillator is not available, turn the unit on with a high gain transistor in the test socket. Connect the VTVM across T2 primary, and set S2 on "LO AC." Gradually increase the supply voltage by turning R20 clockwise and mark reference points on the meter scale, based on the VTVM readings. When full scale is reached, switch S2 to "HI AC" and repeat. Due to the loading effect of D2 and D3, these scales will not be linear. Also, there may be a small standing current that requires the calibration of start part way up the meter scale.

The small transistor socket, upper right on the panel, accommodates over 90% of standard transistors for testing. For other types use the three binding posts located on the left side of the panel, marked E (emitter), B (base) and C (collector).

Testing Procedures. When using the unit, turn the "Leakage Compensation" control and "Voltage" control fully counter-clockwise before starting any test.

Leakage.

1. Set type dial to "PNP" or "NPN" as appropriate.
2. Set type of test dial to "DC."
3. Set base input dial to "leak."
4. Set collector ma dial to "beta."
5. Turn voltage knob to desired value as read on small meter (M2).
6. Move test switch to "check" and read leakage on large meter (M1). (Read on 0-150 scale, where 150 equals 1.5 ma. If



meter goes off scale, switch collector ma dial to higher range).

Beta Check without Leakage Compensation.

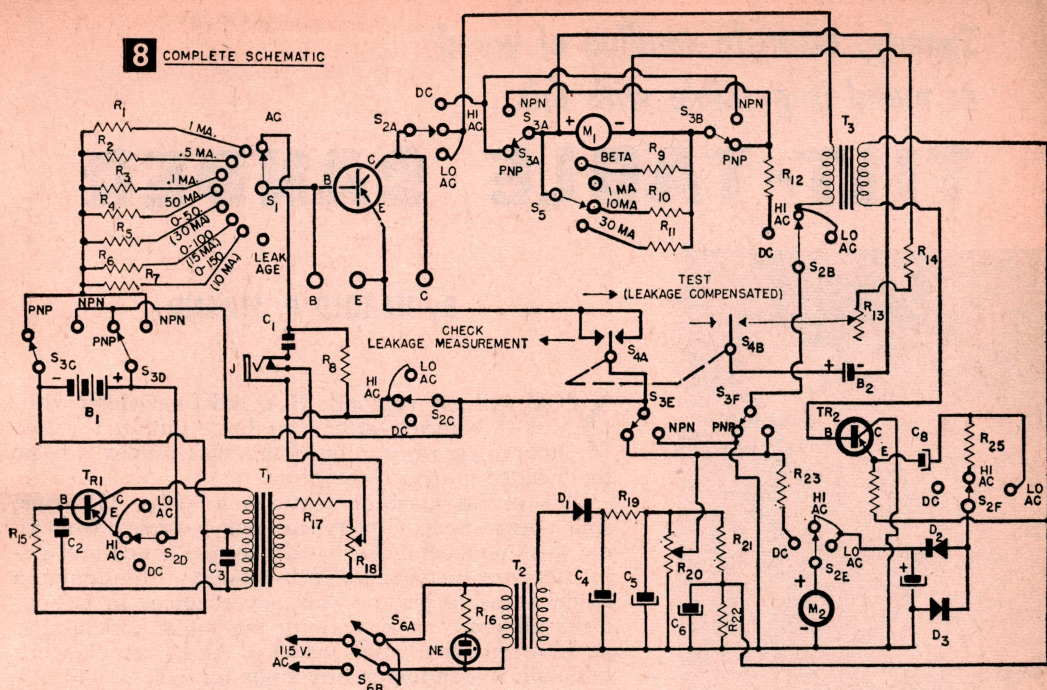
1. Follow steps 1, 2, 4, and 5 above.
2. Set base input dial to estimated beta range.

3. Move test switch to "check" and read beta on appropriate scale of large meter.

Beta Check with Leakage Compensation.

1. Follow steps 1-6 for leakage test.
2. Hold test switch on "test," and adjust "leakage compensation" to zero meter M1.
3. Set base input dial to est. beta range.

8 COMPLETE SCHEMATIC



4. Move test switch to "test" and read net beta on appropriate scale of meter M1.

DC Current Gain Check at Various Input Signals.

1. Set type dial to "PNP" or "NPN" as appropriate, set type of test to "DC," and "voltage" as desired.
2. Set base input dial for input current.
3. Set collector ma dial to estimated output range. (If unknown, set for 30 ma range and switch downward.)
4. Move test switch to "check" and read output current on M1. To get current gain, divide input current (on base input switch setting) into meter reading. (This type of test can also be made with leakage compensated, as outlined above.)

AF Gain Check.

1. Set type dial to "PNP" or "NPN" as appropriate, and set voltage to desired supply voltage, shown on M2.
2. Set base input dial to "AC," and type of test to "HI AC."
3. Move test switch to "check" and read output voltage on "HI AC" scale of M2. If reading is low, move type of test to "LO AC" for better reading. (Since input signal is .1 volt, AF voltage gain will be the meter reading multiplied by 10.)

Caution. Whenever turning the unit off, do not leave the type of test switch on either ac position, since the internal oscillator is drawing current from the mercury battery in this position.

Clothespin Switch

A plastic, spring-loaded clothespin makes a nifty emergency switch for *low voltage* circuits. It offers something more sophisticated than a pair of wires which you touch together when you don't have a switch. And it has some merit and application even when the situation isn't an emergency. Furthermore, you are offered a choice of several modes of operation.

The clothespin switch is a momentary contact, normally open switch. You depress the contact or handle end to close the circuit. The pin I used had the necessary holes in the handles. Simply fasten the stripped wire ends

under nuts serving as terminals with small machine-screw heads serving as switch contacts. Fasten electrical tape over the nuts for insulation, and heed this safe rule: Don't use this switch in circuits with more than 20 volts or 1 ampere.

To make a normally closed momentary contact switch, attach the machine screws and nuts at the other end of the pin.

To convert the normally closed momentary contact switch to a regular on-off switch, simply stick a piece of bakelite or thick cardboard between the contacts to effect turn-off.

—F. H. FRANTZ.

**Speedy, accurate sanding of wood
or metal is possible with this**

TILT-TABLE SANDER

By HAROLD P. STRAND

YOU will ask yourself: How did I get along without it before?—after you have put in the few hours necessary to build this disk sander, a basic tool needed in every workshop.

This useful machine features a $\frac{1}{4}$ -hp, 1750-rpm, split-phase or capacitor-type motor (salvaged from an old washing machine or bought second hand) and a 6-in.-diameter metal sanding disk faced with aluminum oxide abrasive paper. This paper comes in cut-out disks all ready to cement to the metal disk and is suitable for either wood or metal. An adjustable work table allows sanding at any angle up to 45° .

Start the Work by cutting out the base to the dimensions given in Fig. 3. Smooth the edges and slightly round the corners. You can make the base of $1\frac{3}{8}$ -in. solid stock, as shown, or of two pieces of $\frac{3}{4}$ -in. plywood glued and screwed together. The laminated plywood construction has the advantage of not warping, a mishap that is possible with solid stock of this width. Thoroughly dried and painted wood, however, will usually hold its shape satisfactorily. Another suggestion is to nail two 1 x 4-in. cleats across the grain on the underside of the solid-stock base to prevent warping.

Make the table supports of hard pine or oak as shown in Fig. 3. Note that their height is governed by the motor shaft height. Secure these supports to the base with glue and #10 x $2\frac{1}{2}$ -in. flat head wood screws.

The Work Table consists of a piece of $\frac{3}{4}$ -in. birch or maple plywood. A top surface of $\frac{1}{8}$ -in. hardboard (or sheet steel) can be added, securing it with #6 x $\frac{1}{2}$ fh wood screws. Bevel the back edge of the table and its top 45° (Fig. 3A). Make the table end-plates of $\frac{1}{8}$ -in. hot rolled steel and attach them with #4 x $\frac{3}{4}$ -in. round head wood screws.

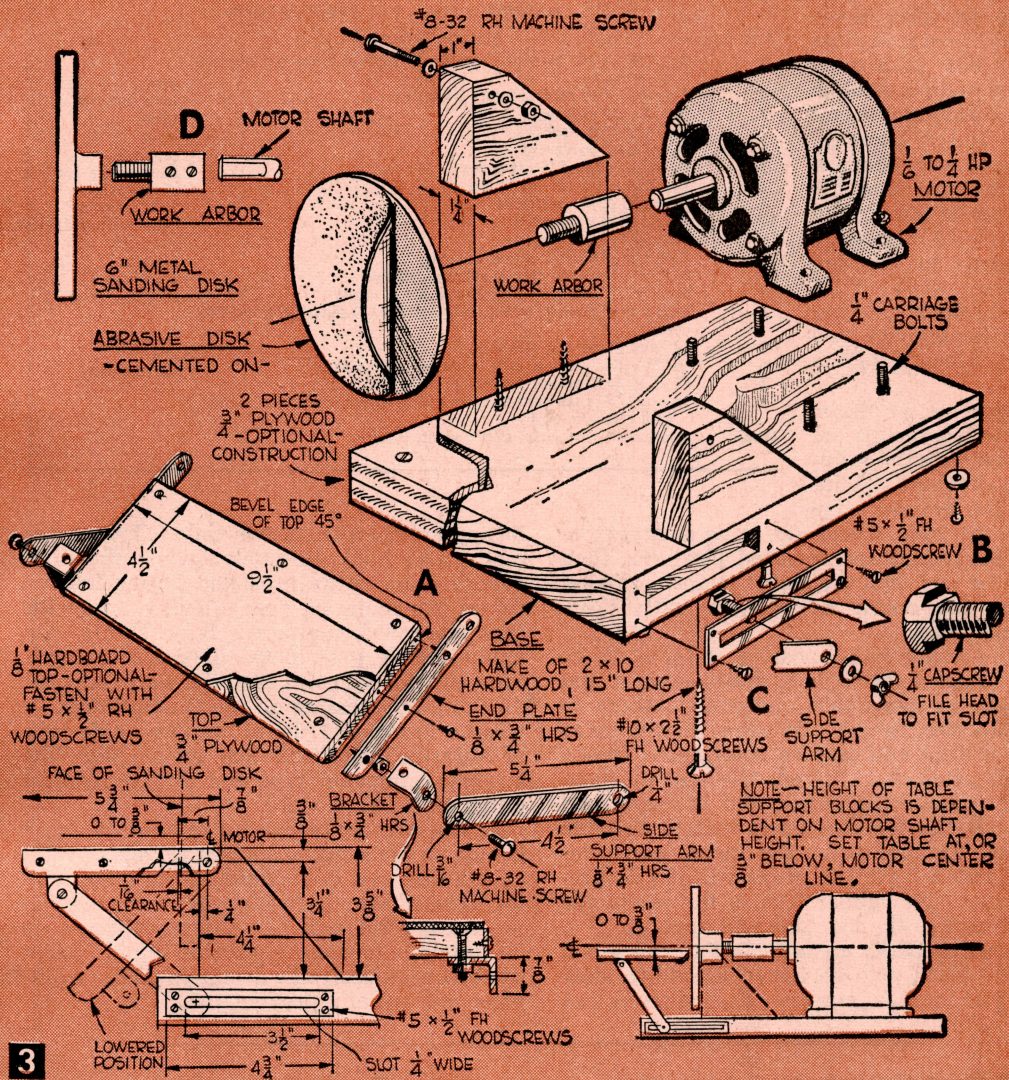
The adjusting mechanism con-



Adjustable from 90° to 45° , the sander is usable for either wood or metal and will save you many times the effort required to build it.

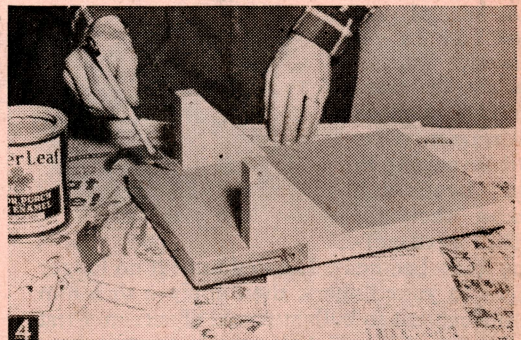


Ready for painting, the tilting table is being checked for free action.



sists of two metal arms (also of hrs) pivoted at one end in brackets secured to the table, and sliding at the other end in slotted metal plates secured to the base. Make the slotted plates by first drilling a series of holes in a straight line, then using a sharp cold chisel to cut out a rough slot. Finish the slots with a smoothing file. The work should be carefully laid out and positioned so that when assembled the table can be adjusted smoothly to any position up to 45° for angle sanding.

File shoulders on the heads of a couple of 1/4-in. capscrews so they will slide in the slotted plates without turning (Fig. 3B). The wood behind the areas where the slotted plates attach to the base must be grooved to clear the heads of these clamping screws



After checking out the unit mechanically disassemble it, then enamel it to match your shop equipment.

(Fig. 3C). Use a small gouge for this work.

The work arbor (Fig. 5D) is a purchased item available at hardware stores and mail order houses. One end must have a smooth bore that fits your motor shaft; the other end must be threaded to fit the sanding disk. File wrench flats on the arbor for convenience in attaching it to the disk.

Mount the Motor on the centerline of the base with the sanding disk about $\frac{1}{16}$ in. from the beveled edge of the tilt-table. Check the table clearance in both the raised and lowered positions, then mark for and drill the motor mounting holes. Secure the motor in position with $\frac{1}{4}$ -in. carriage bolts.

If the motor has excessive end-play in its shaft (more than $\frac{1}{16}$ in.), disassemble it and add one or more thin end-play washers to take up the excess. Be sure, however, to leave a little end play so rotor turns freely.

Then after checking out the unit mechanically, remove the motor and tilt-table and paint all the wooden parts with a suitable enamel. Do not paint the metal parts; instead, rub a light film of oil on them to prevent rust. Fit rubber feet to the underside of the base so the machine will not slip.

Abrasive Disks are attached to the metal sanding plate with an adhesive sold in stick form just for this purpose. This adhesive can

MATERIALS LIST—TILT TABLE SANDER

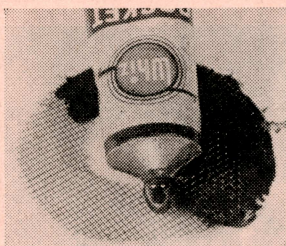
Amt. Req.	Size and Description	Use
1	$1\frac{1}{2} \times 9\frac{1}{2} \times 15''$ hardwood (use 2 x 10 stock or 2 pcs. $\frac{3}{4}''$ plywood —see text)	base
1	$1\frac{1}{4} \times 3\frac{1}{2} \times 6''$ hardwood (use 2 x 4 stock)	table supports
1	$\frac{3}{4} \times 4 \times 10''$ plywood	table
1	work arbor (see text)	motor
1	$\frac{1}{8} \times 4 \times 10''$ hardboard	table top
1	$\frac{3}{32}$ or $\frac{1}{8} \times \frac{3}{4} \times 24''$ crs or hrs	arms, plates, brackets
1	$\frac{3}{32}$ or $\frac{1}{8} \times 1 \times 10''$ crs or hrs	slotted guides
4	#10 x $2\frac{1}{2}''$ fh woodscrews	table supports
14	#5 x $\frac{1}{2}''$ fh woodscrews	table top-slotted guides
6	#4 x $\frac{3}{4}''$ rh woodscrews	end plates
2	8-32 x $1\frac{1}{8}''$ machine screws and nuts	brackets
2	8-32 x $\frac{1}{2}''$ machine screws, nuts and locknuts	arm pivots
2	$\frac{1}{4}$ -20 x $\frac{3}{4}''$ cap screws with washers and wingnuts	clamping screws
2	8-32 x $1\frac{3}{4}''$ machine screws, with 2 washers, 2 nuts, and 2 locknuts each	
4	$\frac{3}{4}''$ dia. rubber feet with screws	table pivots
4	$\frac{1}{4}$ -20 x $2\frac{1}{2}''$ carriage bolts, with nuts and washers	base
1	6" or 8" sanding disk (see text)	motor mount
1	$\frac{1}{4}$ hp, 1750 rpm, split-phase or capacitor type motor, new or used, with extension cord	
Misc.	assorted abrasive disks, stick cement, enamel	

be applied in either of two ways: Operate the motor and hold the stick against the disk, covering the entire area and letting friction soften the material, then quickly apply the sandpaper disk and press it on firmly. Or, apply a little heat to the disk with a torch, then rub the adhesive onto the warm surface, finishing by pressing on the sanding disk. It will be found that the aluminum oxide type of abrasive disks will last longer than the straight sandpaper type and can be used for either metal or wood.

In use, always be careful to hold the work firmly, as the sanding surface travels upward at one side and downward at the other. On the upward side there is always a chance that the work piece will be suddenly thrown up off the table to cause a possible injury. Light sanding pressure and a firm hold on the work-piece will usually prevent this.

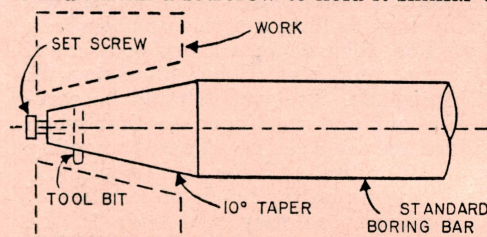
Making Gaskets from Screening

• You can make that special gasket for lawn mower, marine engine or tractor from a piece of screen wire. Cut screening to the necessary shape, then fill with hard-setting gasket cement. Let dry until it no longer sticks to your fingers, then apply a thin film of the cement to both surfaces of screen. First making sure the parts to which it is to be applied are clean, bolt the gasket into place before the second coat of cement has dried.—M. A. TIDD.



Taper Boring Bar

• A specially-made tapered bar can be used to avoid excess vibration when boring tapered holes on your lathe with a tapering attachment. Cross drill the bar for the tool bit and install a setscrew to hold it similar to



standard boring bars. Then turn the 10° taper. The slender taper will reach into holes of relatively small diameters, yet it has sufficient strength for boring deep holes.

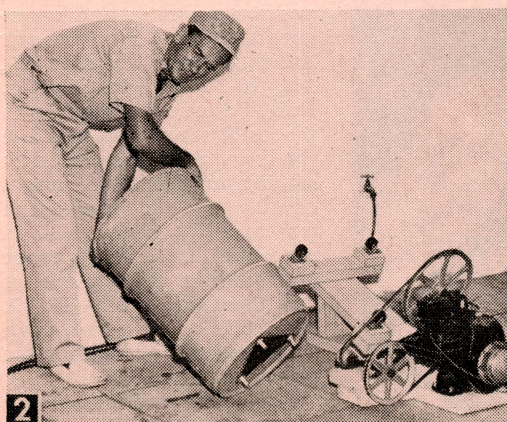


Handy Cement Mixer

A good way to make concrete is to pre-measure your ingredients, start the mixer, and gradually load the drum. While the cement is blending, you'll be free to work on other parts of the job.

A discarded grease drum, some scrap parts, and a borrowed gas engine make home cement repairs a pleasure

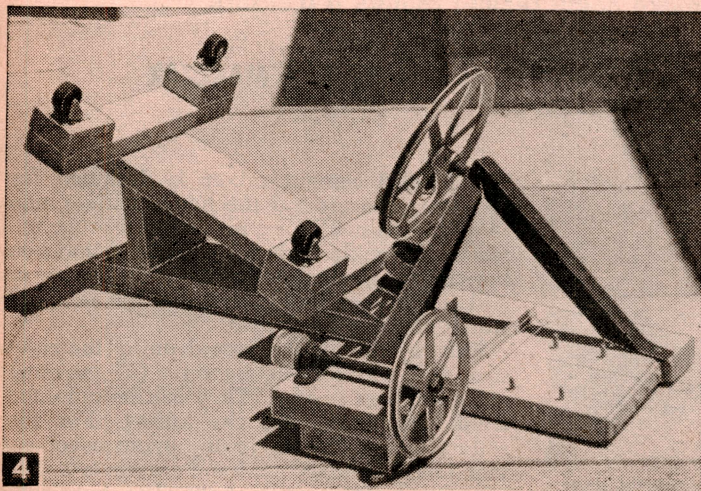
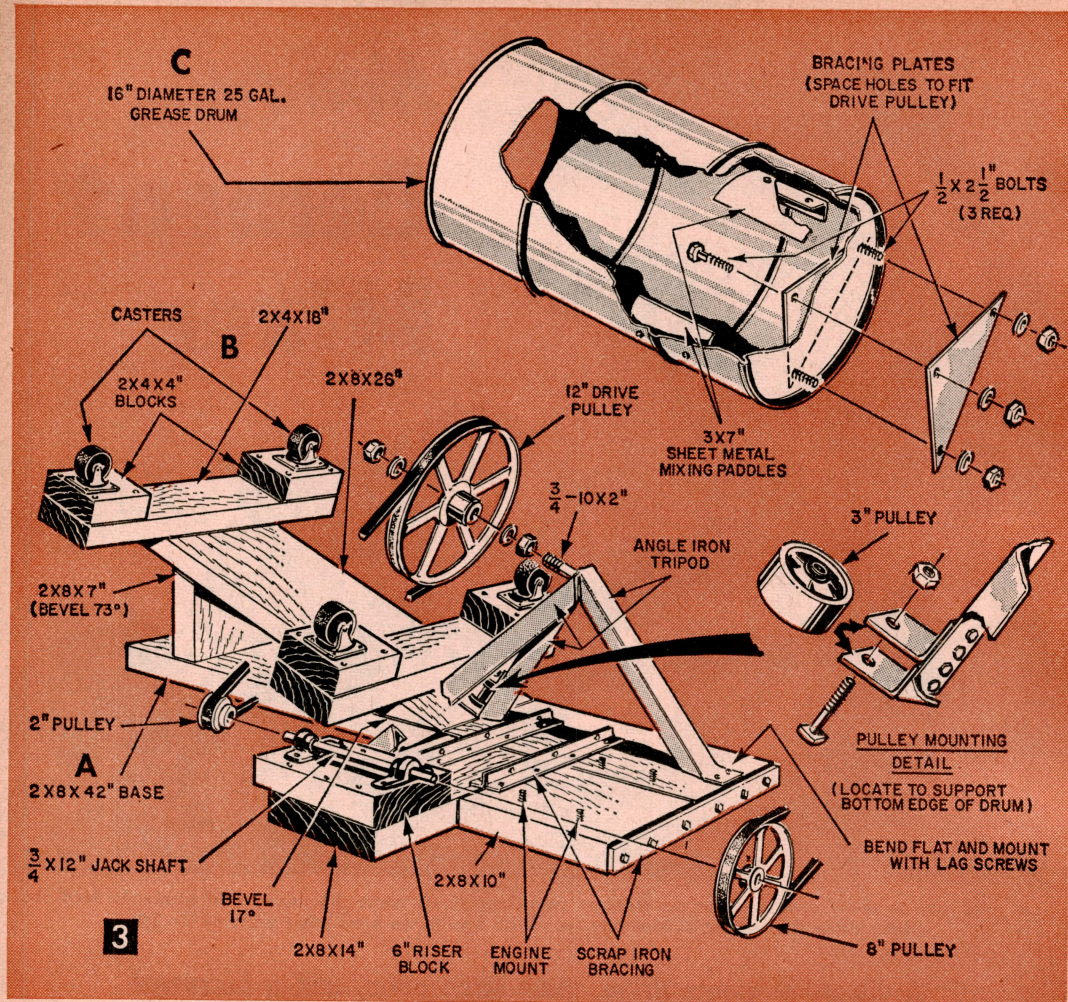
By V. J. MARCZAK



When the cement is thoroughly mixed, lift the drum off the cradle and roll or dolly it to the pouring site. A spare drum and a helper will enable you to mix cement continuously.

THIS \$10 cement mixer is designed for those jobs around the home, garage, and patio too small for a load of ready-mix and too big to tackle by hand. Provided that you borrow the gas engine from a lawn mower or go-kart you can build the mixer for \$5 to \$10 worth of scrap and parts.

Start by finding a grease drum of the right size. One with a 16-in. diameter (25-gal. size) gives the best results. They can be obtained from gas stations for the asking. For the rollers on which the mixing drum revolves, you'll need four second-hand casters or a pair of roller skates cut in half. The base will require a piece of $\frac{3}{4}$ -in. plywood, 42x22 in., or scrap lumber pieced together.



The jack shaft gives you about a one-fourth reduction in speed. The base can also be made of a single piece of heavy plywood. Fasten the throttle cable to one of the engine head bolts.

If $\frac{3}{4}$ -in. plywood is handy, use it as a base and disregard Fig. 3A. Otherwise saw 2x8-in. lumber down to 42-, 14-, 10-, and 6-in. lengths. Nail and brace together with pieces of scrap iron to make the base. Start the cradle by sawing another 26-in. length of 2x8 lumber. Bevel one end to a 17° angle. Nail in place and brace at the other end with a 7-in. piece of 2x8 beveled (73°) to fit. The 6-in. 2x8 piece will serve as a riser block for the pulley assembly.

Make the cradle assembly (Fig. 3B) by nailing four 2x4x4-in. blocks on the ends of two 18-in. pieces of 2x4 lumber. These blocks are risers that support the roll-

ers, so plan your nail locations so they won't interfere later on with the screws that hold your casters in place. Nail the arms to the cradle with the 18-in. pieces about 19 in. apart.

Angle iron cut from an old bed frame will make a fine support for the 12-in. drive pulley. Cut one piece of angle iron 29 in. long, hack-saw notches and shape into a V as in Fig. 3A. Cut another 15-in.

piece and form to complete the tripod bracket assembly. If you are using a pulley with a $\frac{3}{4}$ -in. bore (available at hardware stores), use a $\frac{3}{4}$ -in. x 10 *hd* machine bolt 2 in. long as a shaft. Drill the angle iron to fit, and mount the pulley with washers and two nuts, adjusting so that the pulley is held firmly but is allowed to turn freely.

Now mount the support bracket on the base, and install the casters. To keep the loaded mixing barrel from sliding down on the cradle, add a 3-in. flat pulley at the base of the tripod bracket.

The Mixing Barrel is driven by three $\frac{1}{2}$ x 2 $\frac{1}{2}$ -in. studs bolted to its bottom, which engage the spokes of the drive pulley. If you happen to be using a solid flat pulley, drill holes accordingly to match the studs. Use two locknuts on each stud for a solid grip. Make two 3x7-in. mixing paddles from heavy sheet metal. Bend the metal into a slight curve, bolt on short strips of angle iron, and fasten inside the barrel with nuts and bolts.

The purpose of the jack shaft is to reduce the drum speed to about 60 *rpm*. At the same time, the right speed reduction ratio will allow your gas engine to turn over at higher, more efficient, speeds. Use an 8-in. pulley on the engine side and a 2-in. pulley on the end of the shaft. Arbors shown in the photos came from the axle assembly of an old wheelbarrow. You can also obtain inexpensive die case pillow blocks at your local hardware or mill supply store.

Before you mount the jack shaft solidly in place, check your belt sizes. The easiest way to fit a belt is to use an old fan belt from a car. Cut it at one place, and stretch it around the pulleys, measuring the gap in between with a rule. Arrange your belt so there is an inch or so of give, then mount the pillow blocks to the base. Follow the same procedure with the motor.

If your gas engine has a centrifugal clutch, there will be no problem in starting and stopping the mixer. If the engine lacks this fea-

MATERIALS LIST—HANDY CEMENT MIXER

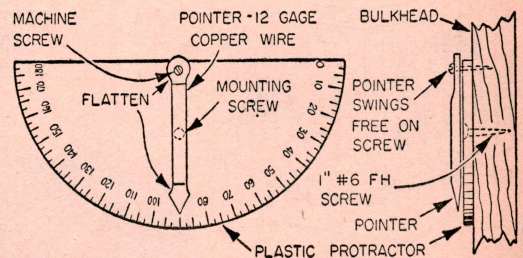
Amt. Req.	Size and Description	Use
1	16"-dia., 25-gal. grease drum, available at garages	drum rollers
4	2" or 3" swivel casters, or roller skates cut in half	
1	3"-dia. flat pulley or caster for bottom of drum	base
6 ft.	2x8" used lumber, or 22 x 44 x $\frac{3}{4}$ " construction plywood	cradle
3 ft.	2x8" lumber	cradle arms
5 in.	2x4" lumber	drive pulley support
4 in.	scrap angle iron, $\frac{1}{4}$ or $\frac{1}{2}$ "	pulley shaft
1	$\frac{3}{4}$ x 10 <i>hd</i> x 2" machine bolt, nuts and washers	jack shaft
1	12"-dia. $\frac{3}{4}$ -in. bore pulley for main drive	
1	$\frac{3}{4}$ x 12" shaft with pulley blocks;	
1 ea.	8"-dia. pulley and 2"-dia. pulley to fit above	
3 ea.	$\frac{1}{2}$ x 2 $\frac{1}{2}$ " bolts (or studs), nuts and washers	
2 ea.	triangular bracing plates to fit drum	
1 ea.	motor belt and drum drive belt to fit.	
	See text	
Misc.	scrap strap iron for base, nails, 16 wood screws to fit casters, bolts to fit engine base, or mtg. for electric motor.	

ture, you can arrange a hinged base for the engine that will allow you to slack off the belt while you get started. Electric motors, $\frac{1}{3}$ *hp* and up, can also be used to drive the mixer, but because they are somewhat slower than most gas engines, you'll have to experiment with various sizes of pulleys and belts. Unless the electric motor is a heavy duty type, you'll also need a hinged base or motor bracket bar, because it takes considerable torque to get the drum with a load of concrete started. If you decide to use an electric motor, *be sure to wire it with the grounded three-wire cord* to prevent shock hazard while you work around damp locations.

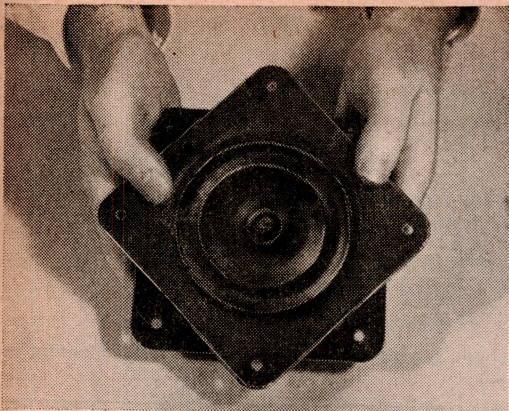
Follow instructions on the cement maker's bag carefully. Never fill the drum to more than one-third capacity. After a trial batch, it's easy to mark a pail or box to get exact mixture proportions. Five to 10 minutes should be enough time to thoroughly blend any mix.

Inclinometer for Small Boats

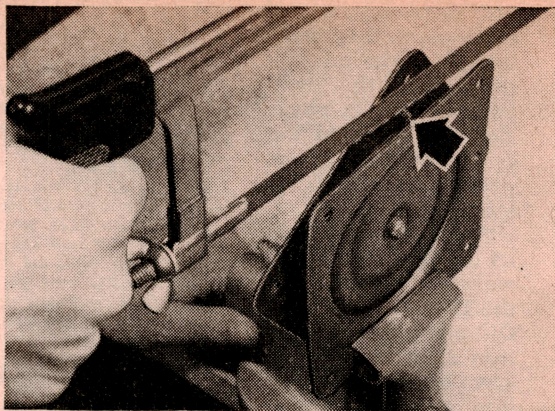
- An inclinometer will help you determine the best trim fore, aft and athwart ship for greatest speed on either sail or powered boat. Make the instrument as shown in the drawing



from a plastic protractor and screw it to a bulkhead. Use to check angle of heel on a sailboat or to indicate correct placement of gear on a motorboat.—W. D. JACKSON.



The kit bearing is 5 in. square. Bearing race is $3\frac{1}{2}$ in. in diameter.



To obtain full circle rotation use a hacksaw to remove one of the stop tabs.

10 Uses for LAZY SUSAN Bearings

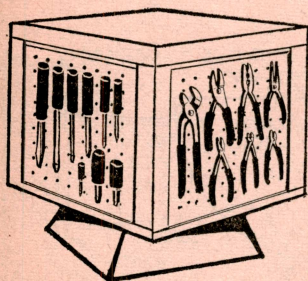
By BILL McHUGH

Take a ball bearing built with flanges for mounting to surfaces, and you've got a swivel device that has hundreds of practical uses in home and shop.

Turntable bearings similar to the one shown range in price from \$3 to \$4. By special arrangement with surplus dealers, a kit including a 5-in. heavy-duty bearing, an 8 x 12-in. steel table base with 3-in. rubber-tipped legs, and mounting hardware can be obtained for only \$2.95. (See Materials List.)

The kit bearing measures 5 in. square. It has stops which limit travel to 90°, intended for the TV base application. The stops can be hacksawed away to give you a full circle rotation.

To mount the bearing between two rotating surfaces, first screw one side to a board. For $\frac{3}{4}$ -in. plywood, use sheet metal screws (supplied with kit). Be sure to drill pilot holes for a tight fit. Then drill an access hole on a radius of $2\frac{13}{16}$ in. to provide a means of tightening the other four screws. The bearing will carry a balanced load of 100 pounds.

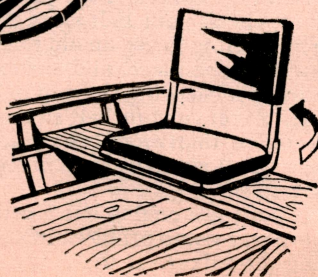


TOOL
RACK

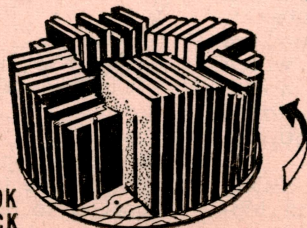
ORDER
PAD
STAND

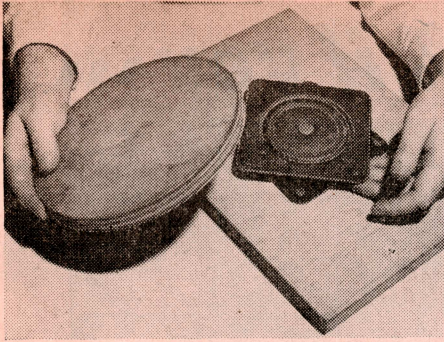


BOAT
SEAT

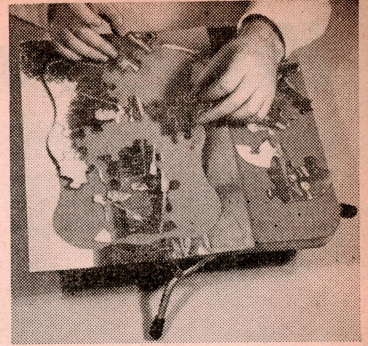
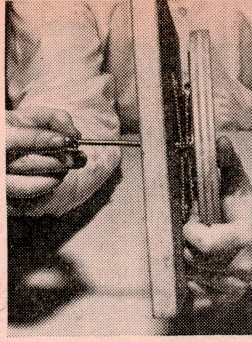


BOOK
RACK

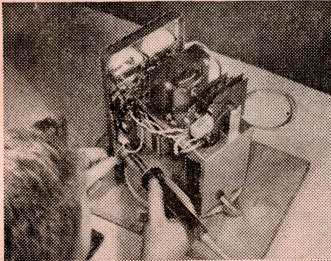




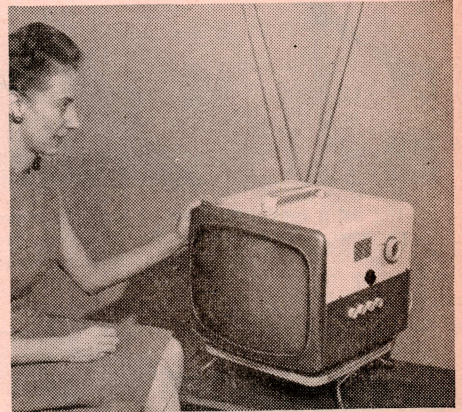
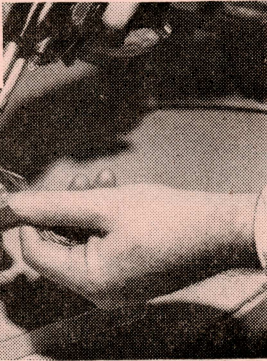
Service bench stand. First screw one side of the bearing to the 11 x 14-in. board. Locate an access hole so the screwdriver can be used to tighten screws in the 7-in. diameter circle. This assembly, with rubber feet added, makes an ideal turntable for salad and party dishes.



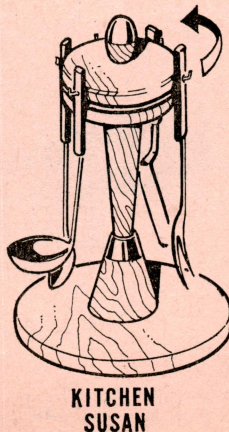
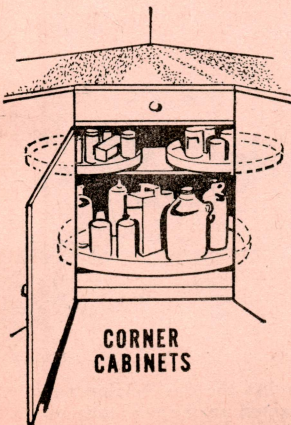
Here's the answer for jig saw puzzle fans. The base works well as a bed unit, for convalescents and children. You can quickly rotate the jig saw puzzle to any convenient angle.



On the electronic bench, the turntable cuts assembly time in half because you can quickly rotate the chassis to the most convenient angle for part installation and soldering.



The kit includes a metal base and the swivel bearing. This TV turntable was made by sawing a piece of $\frac{3}{4}$ -in. plywood cut to fit under the set.



LAZY SUSAN TRAY



MATERIALS LIST—LAZY SUSAN

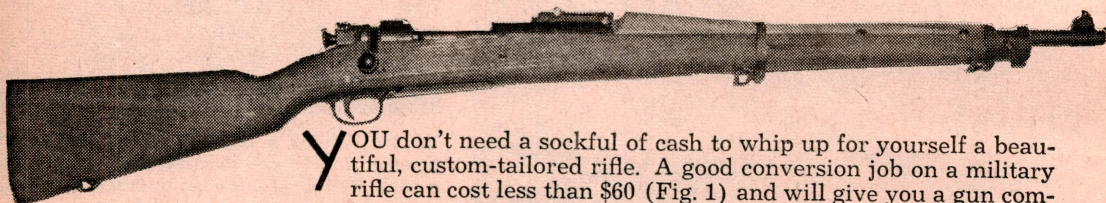
- 1—5" Lazy Susan bearing
- 1—Metal table base with rubber tipped legs—3" high
- 8—Mounting screws

By special arrangement with surplus dealers all of the above items are available in a kit. Send \$2.95 for kit A6 to Science and Mechanics Kit Division, Department 816, 505 Park Avenue, New York 22, New York.

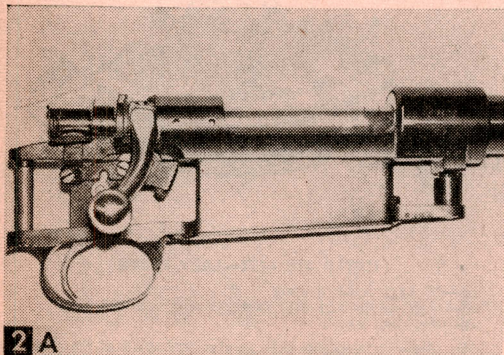
You can save 50% if you ...



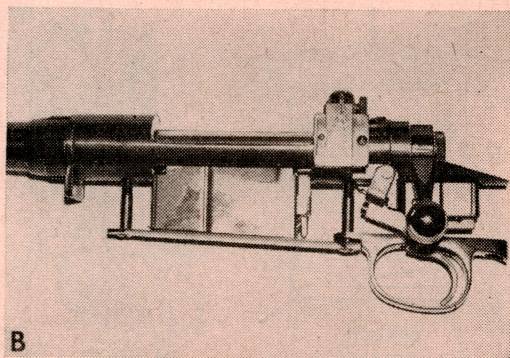
You get a special thrill out of handling a gun you've tailored to your own preferences. It fits you and is as personal as your own hat. See if you can spot the changes the author (above) made in the 1903 Springfield (below) to convert it to a modern sport rifle.



YOU don't need a sockful of cash to whip up for yourself a beautiful, custom-tailored rifle. A good conversion job on a military rifle can cost less than \$60 (Fig. 1) and will give you a gun comparable or superior to any you could buy for twice that price. Or you can buy a complete barrellled action (Fig. 2), fit it with your own custom stock, and for about \$100 end up with a gun that would cost close to \$200 over-the-counter.



2A



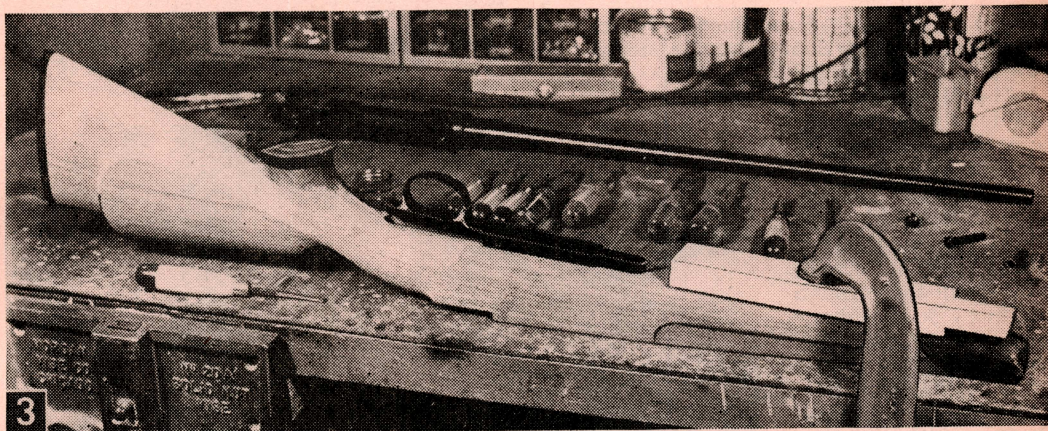
B

Instead of using a military rifle, you can start with a complete barrellled action like the fine Belgian-made F.N. 400 Supreme (left) or the Savage 110-K (right). Both have the safety mounted on the rear tang and adjustable triggers.

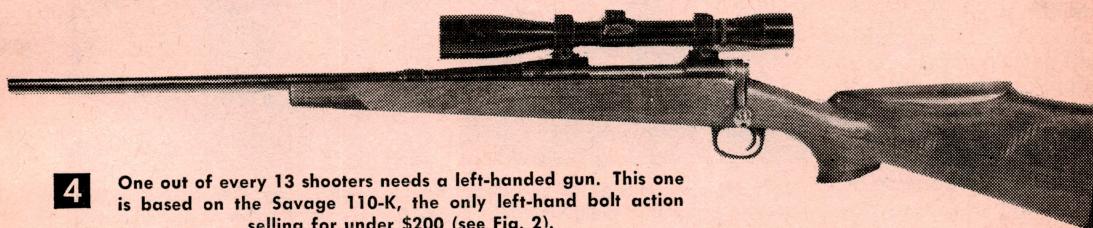
Convert a Military Rifle to a CUSTOM SPORTER

By PATRICK K. SNOOK

Part 1



3 Inletting the magazine box and floorplate with the stock (purchased semi-finished) securely clamped to the bench.



4 One out of every 13 shooters needs a left-handed gun. This one is based on the Savage 110-K, the only left-hand bolt action selling for under \$200 (see Fig. 2).

Here Are Answers to some common questions on military rifle conversions:

- *Are they safe?* According to the technical staff of the National Rifle Assn., they are: "Military rifles of the principal nations have properties of strength and safety to the highest degree that can be obtained."

- *Won't a military rifle conversion be overly heavy?* No. My Springfield conversion weighs only 7½ lbs., about on par with standard-weight sporters of comparable caliber.

- *How about the military trigger pull?* I find nothing wrong with the so-called "two-stage" trigger. You can eliminate the first stage, or spend a few extra bucks and replace the entire trigger mechanism.

- *What kind of military rifle can I get and at what cost?* Probably the most popular for sporter conversion is the U. S. M1903, 30-06 Springfield (Fig. 1), available for \$30 up. Mine cost \$44.95 at Klein's (see Materials List). Others suitable for sporter conversion

are: 7.65-mm Argentine 1909 Mauser (\$25 to \$35); 6.5 x 55-mm 1896 Swedish Mauser; 6.5 x 55-mm Swedish 1938 short rifle; 6.5 x 55-mm Swedish 1894 carbine, and the 30-06 U. S. M1903A3 Springfield.

- *How about barrelled actions?* Several barrelled bolt actions are available. I used the very fine F.N. 400 Supreme (Fig. 4) imported from Belgium for a second gun. Klein's have it in 300 H&H magnum, 264 Win., 30-06, and .270 for \$68.

For my wife, who is left handed, I built up a third gun using the Savage 110 K (Figs. 2A and 4). The 110 is available in 30-06, .243, .270, and .308 Winchester caliber.

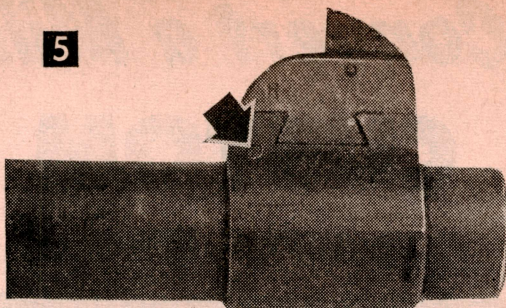
Converting the Springfield. First remove the military stock and guard. If you don't want to cut the barrel, drive out the front sight retaining pin (Fig. 5), tap the sight forward off the barrel, and file off the guide lug.

If you shorten the barrel (average sport-

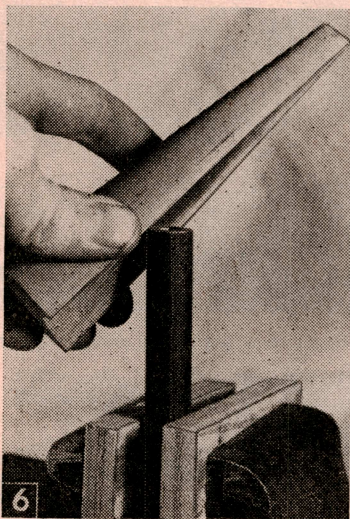
ing rifle's barrel length is 22 in.), clamp it in a padded vise and hacksaw off the excess length, using a high-speed steel blade. Square the muzzle with a fine-cut mill file. Check the end for squareness, allowing for the slight taper in the barrel. Then polish the muzzle with a smooth stone and break the edges with a gouge slip (Fig. 6). Break the inside edges of the bore with a round-head steel bolt smeared with valve grinding compound (Fig. 7).

The Springfield rear sight mounts on a sleeve at the rear of the barrel. Knock out the retaining pin, then drive the sleeve forward and off (Fig. 8).

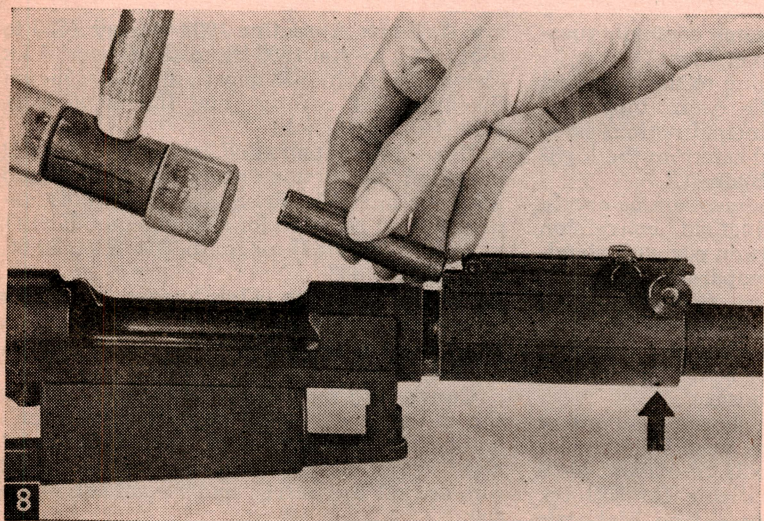
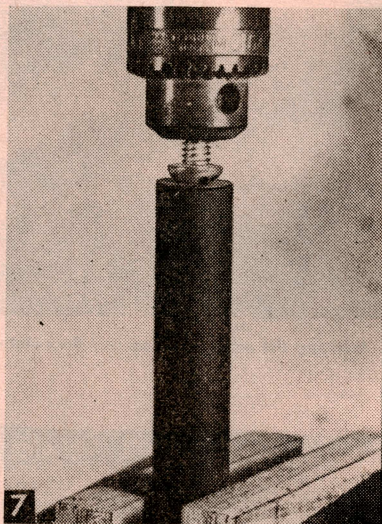
The Finish on most military rifles is a far cry from even the crudest blued finish on a commercial sporter. The Springfield looks like it was sandblasted, but a little effort will transform those rough surfaces to a mirror smoothness that will take a blue comparable to the finest custom rifle. Do the rough buffing with a cotton buffing wheel dressed with medium grit abrasive. Disassemble all parts for this operation, and buff until all surfaces are smooth and free of machining marks. Take care not to round off corners or let wavy surfaces de-



Business end of the old Springfield had this simple sight. Knock out the pin (arrow) and slide it off the end of the barrel.



Left, After shortening, the end of the barrel is squared up, then finished with a stone to give it a slight chamfer. Right, A round-head screw and some valve-grinding compound chamfer the edge of the bore.



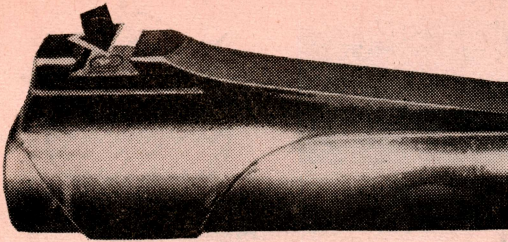
After knocking out the retaining pin (arrow) the Springfield rear sight is tapped forward and slid off the end of the barrel.

velop. Remove no metal from the rear surfaces of the bolt locking lugs or safety lug (Fig. 10). After rough buffing, use white rouge for polishing. For a really spectacular finish, go over all parts again with red rouge.

Some exposed parts of the receiver can't be gotten at with a large buffing wheel. For these use a small abrasive stone chucked in an electric drill (Fig. 11), then finish off with crocus cloth and light machine oil.

Mounting the Sights. Several very fine mi-

9



New sight is force-fitted to the shortened Springfield. Arrow points to retaining screw.

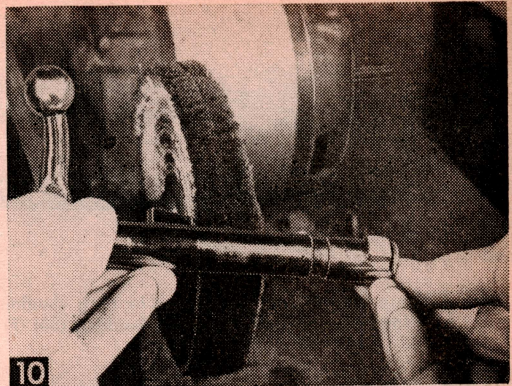
chrometer receiver sights are available for the Springfield. I picked the Lyman 57 SME (\$8.50) because it is one of the ruggedest made and has a quick release so the bridge can be slipped out easily when a scope is mounted or when the rifle is being transported. My choice in a front sight was the Lyman Hooded Ramp with a sleeve fitting (Fig. 9).

To attach the rear sight, drill and tap the mounting holes on the right side of the receiver (or have the sight mounted by a gunsmith). The Springfield receivers (and many others) are case hardened, and you must remove or soften this hard outer layer before drilling mounting holes. It can be removed with an emery wheel (the sight will cover the ground-off area) or softened by spot-annealing with a torch adjusted for a needle flame. Then fit the sight to the receiver and clamp it in place (Fig. 12). Make sure the sight is centered on the receiver and does not interfere with the working of the bolt. Set the windage arm either horizontal or tipped up 1°. Spot the holes with a #26 drill, using the sight as a guide, then drill the actual holes with a No. 31 drill and tap them 6-48. Insert one screw before drilling and tapping for the other.

The Drive-on Front Sight is secured by a pointed lock-screw after positioning (Fig. 9). Align it with the rear sight by bore-sighting.

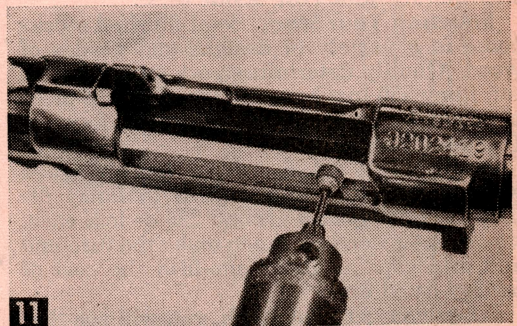
Both the F.N. and the Savage 110 are pre-tapped for Lyman receiver peeps. I used the model 57 FN for the F.N. and the 57 WJS for the Savage. Mounting one of these sights is just a matter of screwing it to the receiver.

While the F.N.'s from Klein's come with a front sight already fitted, the Savage does not. So on the 110 I used a front sight similar to the Springfield's.



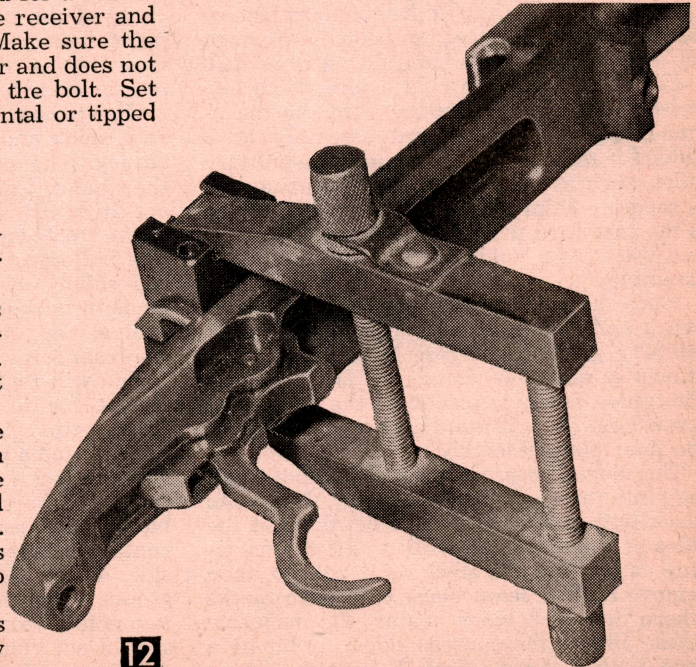
10

Buffing the bolt on a rough-loaded cotton polishing wheel, preparatory to bluing.



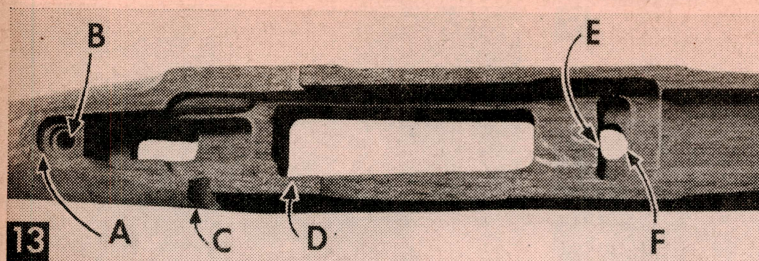
11

Hard-to-get-at places around the breech are smoothed with a small grinding stone, then finished with emery.

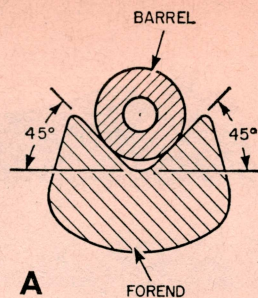


12

New rear sight is clamped in place to act as a guide when drilling the mounting-screw holes.



Stock inletting viewed from top: (A) rear tang shoulder, (B) rear tang screw hole, (C) slot for bolt handle, (D) hole for magazine box, (E) recoil shoulder, and (F) front tang screw hole. Right, Forend cross-section.



After fitting the sights, disassemble your gun and take it to a gunsmith for bluing. Top quality jobs cost about \$4.

Selecting Your Stock. Semi-finished stocks come in a variety of designs and grades of wood. Quality determines cost, and the price can jump \$50 just by going from a plain piece of wood to one with choice grain figuring (see Materials List).

On my three stocks, even using top grade wood and adding some extras in fancy fittings, I kept my cost around \$25 or less each. You can get wood blocks to make the fore-end and grip caps at about one-fifth the cost of factory-fitted ones.

When you get your stock, you will see that "semi-finished" is something of a misnomer. The stocks are completely shaped and require only minor alterations for finishing. The barrel channels are cut to fit the standard factory barrel, and the inletting has been done except for a few areas where hand fitting is needed.

Fit the stock to the rifle before doing any finish work. Start inletting with the magazine-floorplate-trigger-guard assembly as a guide for seating the action. In some military rifles, such as the Enfield, the magazine box is separate from the guard assembly. If this is the case in your gun, fit the magazine first and use it as a guide for locating the guard assembly.

Place the stock upside down on the workbench and clamp it firmly (Fig. 3). A stock inletting guide screw (see Materials List) is almost a must for doing the job properly. The guide screw is placed in the front tang screw hole (Fig. 13) and accurately positions the floor plate assembly.

The magazine probably will fit about half way into the stock on the first try. Mix lamp black with machine oil and lightly coat the sides of the magazine with it. Fit the magazine as far into the stock as it will go, then remove it. The lamp black will leave marks where the stock binds against the magazine sides. Shave these areas down, a bit at a time, with a sharp chisel. Repeat the fitting and shaving process until the magazine seats snugly without binding.

*MATERIALS LIST—CUSTOM SPORTER

Military rifles Klein's Sporting Goods, 227 W. Washington, Chicago 6, Ill.
National Rifle Assn., 1600 Rhode Island Ave. N.W., Washington.
Martin B. Retting, Inc., 11029 Washington Blvd., Culver City, Calif.
Barrelled actions order through local gun shop (Savage, F.N.)
Sights, taps, dies Lyman Gunsight Corp., Middlefield, Conn.
Gunstocks, fore-end tips, grip caps, inletting guide screw, front tang screw... Reinhardt Fajen, Inc., Warsaw, Mo. (catalog \$1)

* For 1 rifle (or barrelled action) get 1 semi-finished gunstock, 1 front and 1 rear sight, 1 inletting guide screw, 1 front tang screw. Fore-end tip and grip cap are optional. Get other items as needed.

Bed the Action, using the front tang screw as a guide. Probably the most critical point in this operation is making sure the action recoil lug fits squarely and solidly against the recoil shoulder in the stock (Fig. 13). Because of the need for an accurate fit at this point, factory stocks come with a little extra wood left on the front of the shoulder. Cut the shoulder back carefully for a good fit.

Uneven seating of the lug could result in a split stock and will surely cause loss of accuracy. The stock bolts should fit loosely in their holes. The edges of the rear tang should not fit tightly against the stock. *This portion of the stock should absorb none of the recoil.* The bottom of the rear tang, however, must bed solidly against the wood. Equally important, is a good fit where the action beds against the top of the recoil shoulder, near the front screw.

You will find the barrel-groove cut to size except for a small area just behind the forend tip. This is where the barrel is bedded, and a precise job is necessary for the rifle to shoot accurately. Trim this area carefully to form a V-stock against which the barrel can rest (Fig. 13A). The points of contact between stock and barrel are at each side, sloped 45° to the bottom of the barrel groove. The barrel should rest against these two points with a force of at least 6 lbs. and should not bind with the stock anywhere.

This completes the bedding of the action. Part 2 of this article tells how to complete the fitting of the stock.

Custom SPORTER

Part 2



The "secret" of a fine hand-rubbed oil finish is a secret no more. The author, shown here hand-finishing his own gunstock, tells how to do it.

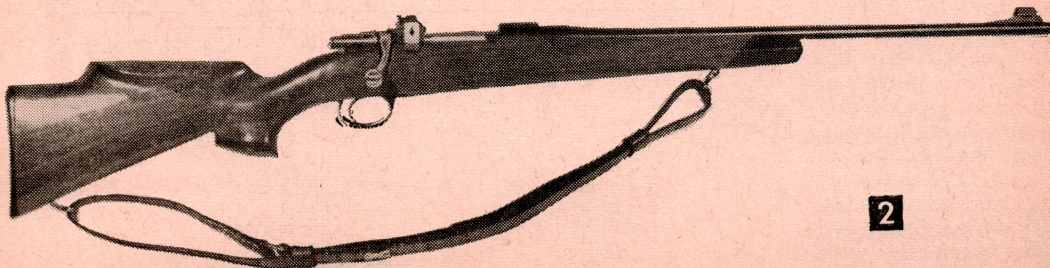
WHEN the action has been properly bedded, trim the stock surfaces down almost flush with those of the action, but leave enough wood for sanding (Fig. 3). On some actions it may also be necessary to inlet a small channel just behind the rear tang, so that the bolt sear clears the stock (Fig. 4).

Assemble the bolt to the receiver to see if the bolt handle cut-out is deep enough for the

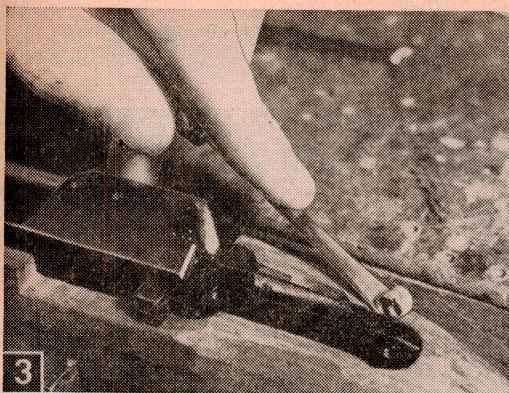
bolt to close completely. You should hear a sharp click when the handle is pulled down. If in doubt, smear the bolt handle with lamp black and oil and check as you did the other parts of the action. Use a small, sharp gouge to relieve the slot if necessary (Fig. 5).

Final Shaping. Once the stock has been completely inletted and the action and barrel bedded, you can begin on the minor dimensional changes that will make yours a custom gun, and distinguish it from run-of-the-mill pieces. To start this work, fit the action in the stock with the sights mounted, and try the gun for fit. See how the forearm feels to your hand when you assume your normal shooting stance. If it feels comfortable, fine—let it alone. I happen to like the slender European style forearm, and since the current trend in this country is towards big flat beavertail and semi-beavertail forearms, I usually end up having to shave the forearm down to about half its original size to get it to feel comfortable in my hand.

Length of Pull (distance between the trigger and the center of the butt) is a prime consideration for comfortable shooting (Fig. 6). This length will vary for different individuals, depending on physical build and shooting form. The average factory stock has a pull of about 13½ in. and supposedly is right for me. I find, however, that I shoot far better after I add about ½ in. to the pull by fitting a recoil pad. My wife, who stands 5 ft. 7 in. and is slender, finds the same stock about ½ in. too long and gets the butt caught in her jacket



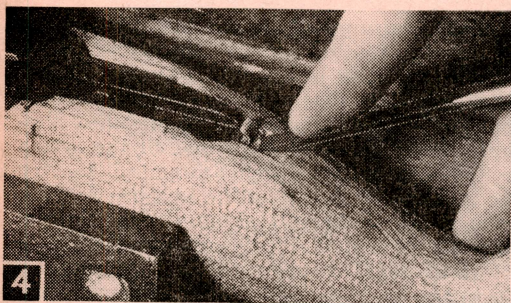
For this fine sport rifle, the author used an F. N. 400 Supreme barreled action, Lyman sights, and a Fajen Aristocrat walnut stock with rosewood fittings.



3 After bedding the action, trim the stock down almost even with the metal, leaving just enough wood for sanding.



5 Using a small gouge to enlarge the bolt handle slot in the stock. The handle should not touch wood in the closed position.



4 On some rifles, it may be necessary to inlet a small channel just behind the rear tang so the bolt sear will clear the stock.

every time she brings the gun up to her shoulder.

The pistol grip may also require a bit of reworking, depending on the size of your hands and how you hold your gun.

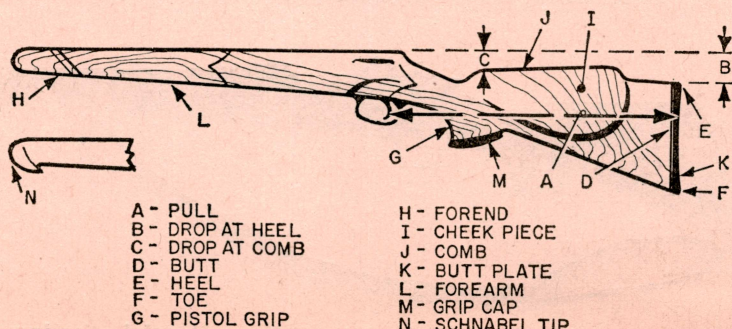
Comb and Cheekpiece. Other points to check carefully are the comb height and the fit of the cheekpiece. I happen to have a rather long neck and a thin face, so I like a high comb and a good thick cheekpiece. A man with a short neck and a thick face, however, will get his teeth rattled every time he fires one of my rifles. A thinner cheekpiece and lower comb will do much to ease the recoil for a person of this build. An ideally shaped cheekpiece will allow the shooter to position his head naturally and comfortably so that his sighting eye aligns perfectly with the sight. Naturally, a scope-sighted rifle will call for a slightly high-

er comb than one that is to be used with open or receiver sights. If you plan to fit your rifle with both types of sights, the best bet is a compromise on comb height—just a bit low for scopes and a bit high for iron sights.

An important factor to keep in mind is that the flat of the cheekpiece should slope slightly *in* and *down* towards the front end of the stock. This takes the recoil down and away from your face. The difference in recoil between a rifle with a properly fitted and shaped cheekpiece and one that is not suited to the shooter is almost unbelievable. For final shaping of the stock take the gun out and shoot it a few times to check the fit. Then make corrections till you get it right.

Excess wood should be trimmed away carefully. Remember, once you take it off, you can't put it back. For rough trimming a coarse "cheese-grater" type file like the *Stanley Sureform* will take wood off quickly, yet won't leave a ragged fuzz as conventional files do. Do the final smoothing with fine cabinet files.

Sling and Swivels. Most people, even if they don't use a sling as a shooting aid, like one on their rifle. I do, and I prefer the snap-



6 PRINCIPAL PARTS OF A RIFLE STOCK

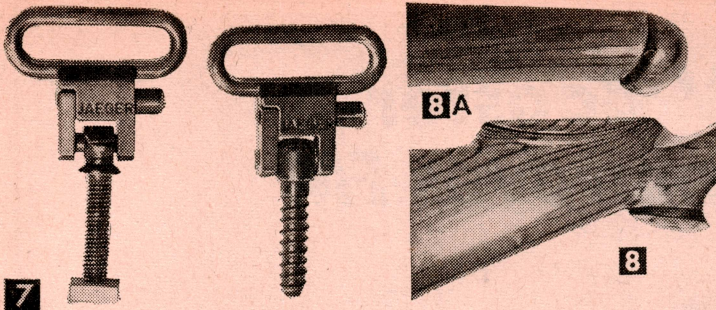


Fig. 7. Quick-detachable Jaeger swivels were the author's choice for attaching the sling. Front swivel is at left, rear at right.

Fig. 8. Outside of the popular rollover comb blends smoothly into the stock. Note contrasting wood grip-cap.

Fig. 8A. Another style of forend finish is the "schnobble" (German schnabel-beak). This is shaped from the forearm of the stock, and is not a separate piece.

on type like the *Jaeger Q. D.* (Fig. 7). These are available at most gun shops, or from Paul Jaeger, Jenkintown, Pa. They are made for $\frac{7}{8}$ in., 1 in., and $1\frac{1}{4}$ -in.-wide slings, and sell for \$3.35 a set.

The rear swivel has a woodscrew type stud and is fitted by simply drilling an undersize hole about $2\frac{1}{2}$ in. from the butt of the stock and screwing the stud in. The front swivel has a machine-screw stud and a small round retaining nut. Mount it by drilling a hole through the forearm, then cutting a recess for the nut. The front swivel should be about 1 in. back from the tip of the forearm unless the stock has an added plastic or wood tip. If it does, position the swivel about 1 in. back of the rear edge of the tip.

Finishing the Stock. Of the many finishes used on gunstocks there is one that even the most critical gun nuts find acceptable. This is the beautiful, classic oil finish traditional with the better European gun makers. It can be achieved effectively only if the wood of the stock is very hard and extremely close grained.

The first step in applying an oil finish is to sand the stock carefully, using successively finer grits of sandpaper. Start with a piece of 80 grit, wrapped around a chunk of rubber (like a large rubber eraser) so that it won't dig into the soft spots in the wood, and work up to 400 grit. Then finish with 600 "wet-or-dry." Do *all* sanding *with* the grain. The 400 should be used to remove completely all scratches and file marks; the 600, used wet, polishes rather than sands. When sanding, be careful not to round edges such as those around the inletting; keep them square.

Wipe the stock between sandings with a wet rag—then dry it quickly by holding it near a source of heat to raise the soft grain or "whiskers." Be careful not to scorch the wood. Sand smooth again and repeat the process, sanding just enough each time to remove the rough whiskers.

Applying the Oil.

When you're satisfied there is no longer the slightest sign of a scratch or file mark, slap on a heavy coat of warm boiled-linseed oil with a brush, or your hands. Then set the stock in a warm, dust-free corner for a day so the oil can penetrate and dry. Check the stock periodically to see if there are any areas that have soaked up all the oil and are dull. Give these areas another coat of linseed and again set the stock aside for drying. Continue this process un-

til every wood pore in the stock is filled with dried oil.

When this is done, sand the entire stock back down to bare wood so that only the filled pores shine. Dust the stock off carefully, then pour a little linseed oil into your hands and rub it into the wood until there are no streaks of oil on the surface. Polish the work with a clean, dry rag and set it aside again for a few days until the oil dries completely. Repeat the process until the wood takes on a glowing sheen. The secret of a successful rubbed-oil finish is many very light coats of oil, well rubbed, and thorough drying between coats. This takes time and is pretty much a labor of love, but if done right no other finish will compare with it for beauty and durability.

Other Finishes. If the wood of your stock is not close enough grained for a true rubbed-oil finish, you can still come pretty close to it by starting with a coat of good quality spar varnish. Apply this to the stock. When it is bone dry, follow the same routine of sanding to bare wood, with only the varnish-filled pores showing gloss, then applying very thin coats of linseed oil, again rubbing each coat in with the hands and polishing with a soft dry cloth. As before, the secret of a good job is many thin coats and thorough drying between applications.

If you don't want to spend the time required for an oil finish, you can take a short cut and spray or brush on the stock one of the better commercial lacquers or varnishes. This is how most factory stocks are finished. This method can result in a good looking job if done properly, but it is susceptible to scratches and nicks and lacks the soft sheen of a good oil finish. Later on you can sand the varnish down and apply an oil finish, as in the previously described method. So choose the method best suited to your skills and preferences, do the best work you can on it, and you will have a gunstock to be proud of.

TV Booster Improves FM



A few adjustments and now this booster works fine with the author's Heathkit FM tuner. The booster turns on automatically with the FM, and daughter retunes only when a peak boost is needed.

GOOD FM reception is no problem if you live close to a transmitter. This idea is intended for suburbanites, fringe area listeners 50 to 100 miles from a station, and for those who live in shadow areas, hilly country, and in other spots where FM coverage is poor.

Only a screwdriver and a few "by ear" adjustments are needed to adapt a common TV booster to FM use. Because many parts of the country are now serviced by new local TV stations, boosters are rapidly becoming obsolete, and you can often pick them up for as little as \$3 in resale shops or from TV servicemen.

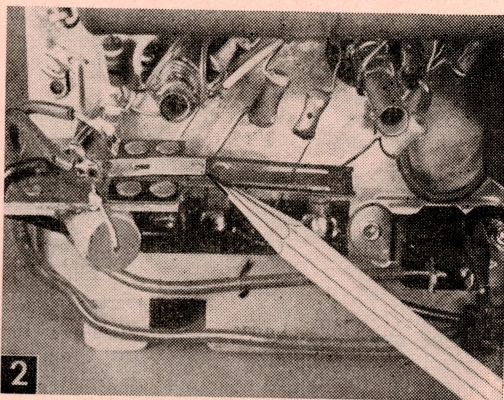
Using the booster shown in Fig. 1, these improvements resulted: 1. Four borderline stations were boosted to "very good". 2. Five formerly inaudible stations were boosted to an evening listening level. 3. All other stations within range improved in reception, both day and night. 4. The listenable range of the receiver extended out beyond 100 miles, and at times stations 200 miles away and more were heard working only with an ordinary antenna 21 ft. above ground level.

Of course, a booster cannot create good signals out of fading or sporadic FM transmission. But it can increase your enjoyment of regularly received weak stations since it eliminates distortion produced in many receivers when they are forced to overcome the limiting threshold of many FM receivers.

Your best bet for buying a discarded TV booster would be a TV shop that has been in business for more than a few years. During that time, most of these shops have accumulated a small stock of the boosters, and they usually are glad to sell them for a few dollars. *But be sure to avoid the single-channel types, and those that will not tune chan-*

A discarded TV booster is the answer for improving your FM -- a good idea for DX fans too

By JOSEPH R. NOONAN



The pencil tip points to the thermal element of the booster's automatic switch. When line current passes through, the strip bends to close the contacts.

nels 2 through 6 continuously. Since the FM band lies just above TV channel 6, you need the simple type of booster circuit that has a plug tuning feature. The booster in Fig. 1 is an Alliance model AB-3. However, Bogen, Regency, and Jerrold also produced similar boosters that will work the same way.

Only Two Adjustments are Needed. First, your booster probably has a thermal switch which turns power on automatically when the

TV switch is on (Fig. 2). When line current passes through the thermal element it warms, and bends to close the contacts. These switches are designed for TV set wattages, so if your FM unit draws over 140 watts you'll be able to simply plug it in, and it will work just like the TV set. However, if your FM draws between 100 and 140 watts, you'll need to adjust the contact points with a screwdriver until your FM wattage will operate the thermal switch. Below 100 watts, these adjustments become critical, so if your FM is in the 50- to 100-watt bracket, simply close the booster contacts permanently and install a line switch on the booster.

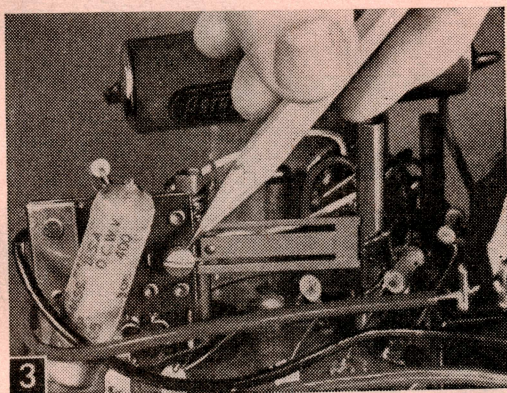
Your Second Adjustment is Tuning. Attach your FM antenna to the booster antenna terminals with twin line. TV antennas can be used with good results on FM, but don't at-

tach both a TV set and the booster simultaneously to one antenna without using a set coupler, or a loss in signal strength will result. You can also attach a booster to an antenna extension outlet, though there is some danger of boosting interference picked up by the extension system if it is large or passes near appliances and other sources of interference.

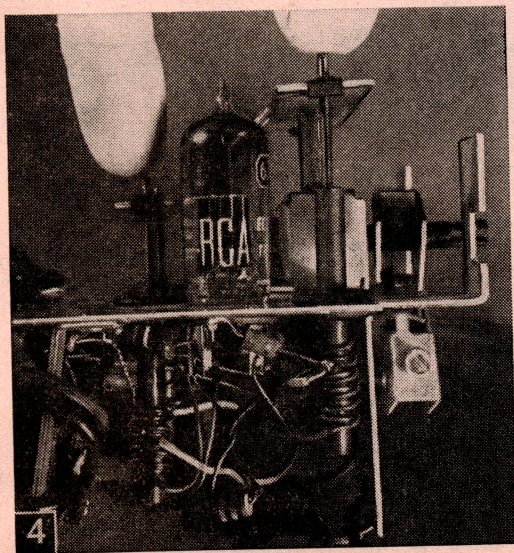
Now connect your FM set to the booster and adjust the booster tuning knob to the highest point that it will tune on channel 6. Tune the FM to a station near the 88-mc end of the dial. Next rock the booster tuning knob and watch the mechanical tuning linkage inside—you'll see several screw-adjustable slugs moving in and out of coils. To determine which slugs to adjust, examine the coils and select the pair with the most turns of wire. With the station tuned in, slowly unscrew (out of the coil) first one slug and then the other until you obtain the best signal.

Next turn the channel selector toward channels 4 and 5 until the signal weakens, and then repeat the slug tuning step to obtain maximum signal strength. Ear-tuning for volume is fine, but if your FM has an eye or tuning meter, it will help you. Now tune the FM to a station near 108 mc, and adjust the booster channel selector for maximum signal. If station is not boosted fully, even with your channel knob as high as 6, unscrew the slugs slightly until you get maximum boost. But do not unscrew the slugs more than necessary, since the booster circuit could be unstable.

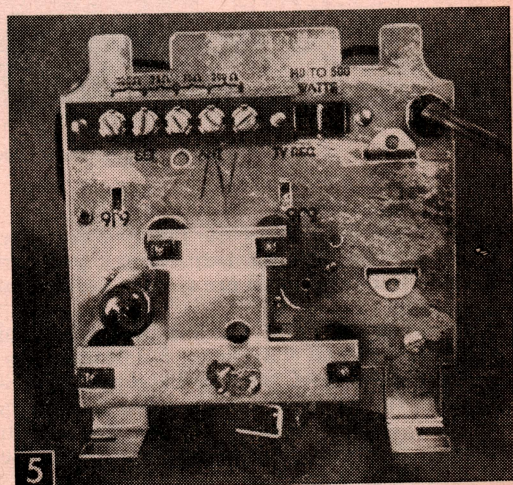
With adjustments completed, you should now notice a signal gain on any station, but for maximum boost of any one, fine-tune with the channel selector knob.



Adjust this screw to lower the thermal switch to operate with the lower wattage of your FM set.

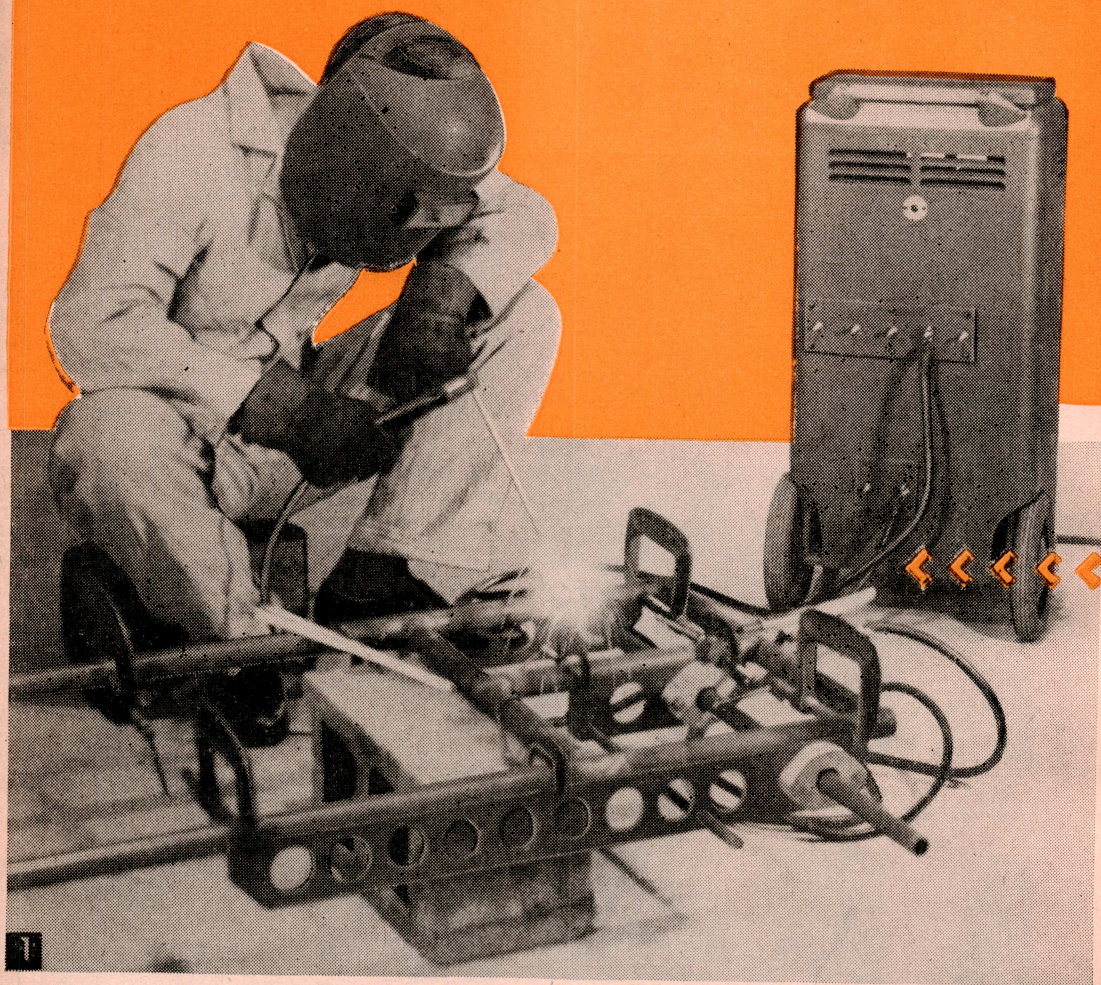


These are the screws that adjust the tuning slugs within the coils.



Top view of booster chassis shows receptacle at the top for the TV, or FM power cord. The empty tube socket is part of the channel 7-13 section not needed for operation as an FM booster.

Make An ARC WELDER



If you're going to work with metal, a welder is almost a necessity.

FOR little more than the price of the wire it takes to wind the transformer, you can have this fan-cooled arc welder perking in your shop.

Jumping-off Point for this versatile tool is a discarded fast charger for 6-volt batteries. Many of these have gone bad and are gathering dust for want of repairs, since nowadays service stations usually replace them with the new 6/12 volt charger so they can handle both battery sizes.

We got ours (Fig. 2) in a neighborhood gas station just for hauling it away. It had a burned-out transformer, but all we needed was the silicon-steel laminations that make up the transformer core, so that was no dis-

advantage. The rest of the charger, cooling fan, two 100-ampere cables, heavy duty line cord, and cabinet with wheels all were needed and useful items for building our welder. Later we picked up a second burned-out transformer (also for nothing) at a place that repaired chargers, in order to get more of the silicon steel.

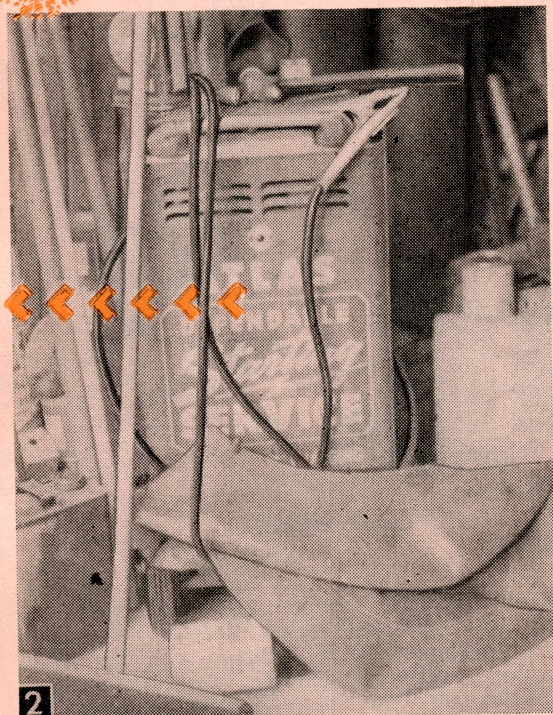
Whether you start with an old *Atlas* charger as we did (Fig. 2), or some other make, you will need the same main components. Be sure to get transformers that have "E" and "I" type laminations (see Fig. 3B). You must have enough of these to build up a cross-sectional area within the coil (Fig. 3A) of 8 to 10 sq. in. By following these

From a Battery Charger

operates on 110/120 volt ac house current, gives choice of 10 heats for wide range of jobs

By D. MINDER

Craft Print Projects No. 328



Rescued from the scrap heap, this old battery charger provided the main components for the flexible welding outfit in Fig. 1.

instructions carefully, you can construct a welder out of any one of quite a variety of old battery chargers.

To Start, remove everything from the charger you have found—cables, switches, meter, fan, and so forth—and clean out the cabinet and paint it. The cooling fan probably will have collected its share of dirt and grime. Dismantle it, clean it, and lubricate the shaft bearings. Don't lose the end-play washers on the armature shaft. The battery cables, if still usable and long enough, will be fine for electrode and ground cables as they are of 100 ampere capacity and come equipped with spring type battery clamps. Wire-brush the clamps and pick the best for a ground clamp. Replace

the other clamp with an electrode holder, available from local welder's suppliers (or see Materials List). The heavy duty terminal lugs on the opposite ends of the cables are usable on the welder but must be reinforced for the new service. Wrap the cables with friction tape, starting about 2 in. back from the lug, and lap it tightly up over the body of the lug. Three or four layers will be sufficient. After the cables are taped, give the wrappings three or four coats of white shellac, allowing it to dry between coats.

This welder design is based on an "autotransformer," the single winding of which serves for both primary and secondary circuits. An autotransformer requires less material for a given output than a double-winding transformer: on the other hand, if the same amount of material is used in both, the output of an autotransformer will be greater.

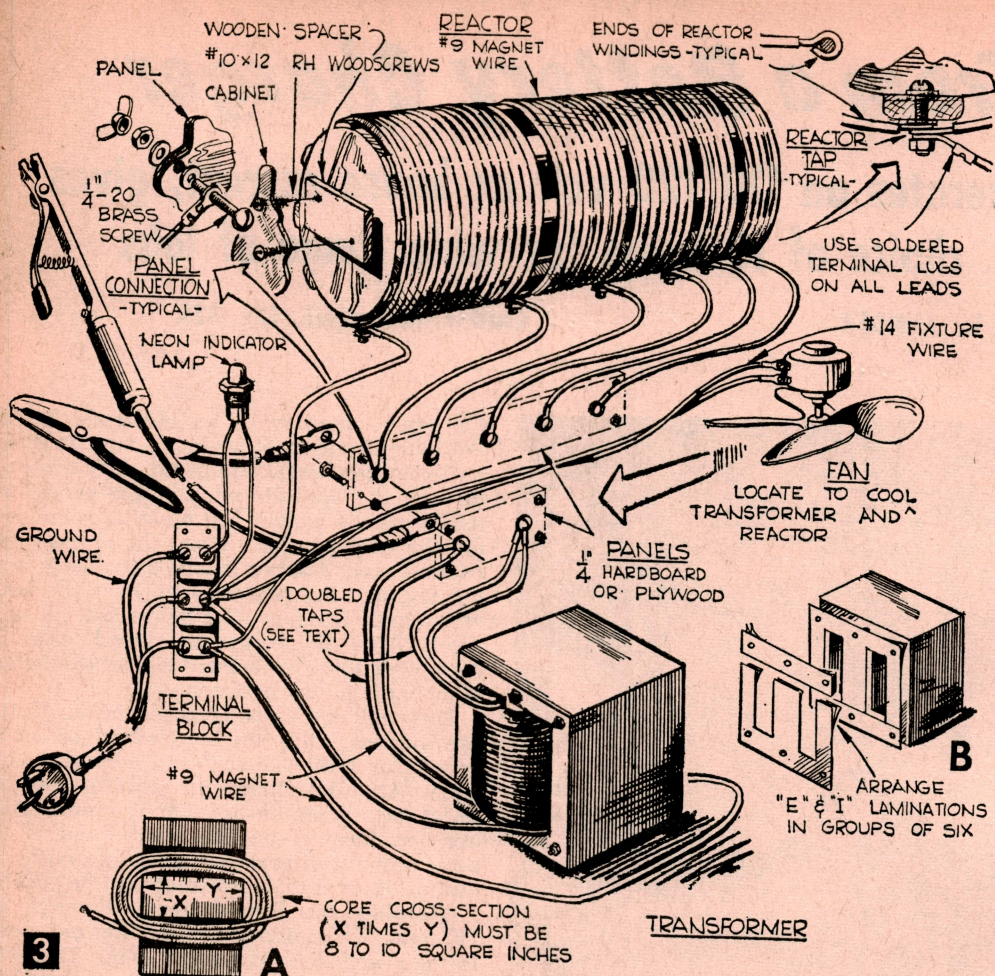
Building the Transformer. Remove the "E" and "I" laminations from the old transformers and discard the old coils. Don't try to use this wire again even if some of it looks good—the enamel is bound to crack.

Remove one core lamination at a time and stack the "E's" and "I's" separately. You will probably find the "E's" arranged 10 to 12 deep inserted from one side of the winding and 10 to 12 deep inserted from the other side, with the "I's" filling the spaces between. Measure the lamination thickness in the two transformers and, if not the same, keep them separate when stacking.

For the new transformer, it is necessary to have a core cross-sectional area (Fig. 3A) of 8 to 10 sq. in. Stack six "E" laminations on the bench, then lay another stack of six on top, with the arms of the "E" pointing in the opposite direction, and continue to lay them up in alternate groups of six until you have enough to give the desired cross-section. Separate the "I" laminations in stacks of six also and put them to one side. If you are using two *Atlas* transformers, you will have enough laminations to give a total height of 4 in.

Winding the Coil. Make a wooden coil winding form (Fig. 4A), basing the dimensions on the transformer lamination dimensions

SURPLUS and SALVAGE PROJECTS



you are using. The winding must not extend beyond the end plates, except at the top and bottom of the form where it does not matter.

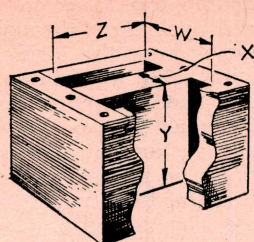
You can use No. 9 D.C.C. (Double Cotton Covered) wire for the coil, or No. 9 D.C.C. Enameled, No. 9 Enameled, No. 9 Formvar, or No. 9 Nylad (see Materials List). Get about 300 ft. or 12 lbs. This will give enough for the transformer winding, the reactor, the cabinet wiring, and an allowance for a few mistakes. (The transformer figures about 172 ft. including leads, based on the length of the outside turns, and the reactor uses about 88 ft., for a total of 260 ft.)

Cut strips of Bristol Board (or heavy cardboard of the type used by clothing stores for suit boxes) to fit around the coil form (Fig. 4B). Wrap the cardboard around the block tightly, butt-join the ends and fasten with masking tape. Give it a coat of white shellac and let dry; then wrap another strip over the first, butt-join the ends opposite the first joint, tape, shellac, and dry.

Start Winding the coil by taping the wire to the shellacked coil form at the end of the

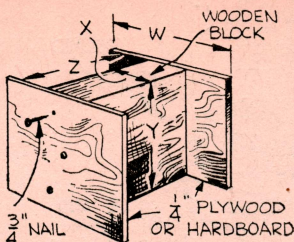
block (Fig. 4C). Leave an 18-in. lead extending out from the block. Mark a piece of masking tape "START," fasten it to the 18-in. lead, and begin winding. You should be able to get about 18 to 20 turns per layer. Wind each layer directly upon the one under it. To get the wire to "lay" when winding, pull the wire down over the form between thumb and index finger and slightly arch the wire inward toward the form with the thumb. After each layer is finished, place the coil on a soft pine block that fits between the end plates of the form, place another similar block on top, and tap it (against the sides of the windings) with a rubber mallet to "set" the wire on the form. Don't tap too hard and ruin the insulation, and don't tap the ends.

Continue winding until you have wound $67\frac{1}{2}$ turns. This will bring you opposite the starting point. Tape the wire down to the form, then bend it outward and cut it off, leaving an 18-in.-long lead (Fig. 4D). Label it No. 1. Now, double back on this lead and resume winding. Wind nine more turns, make a second doubled 18-in. lead (No. 2), cutting

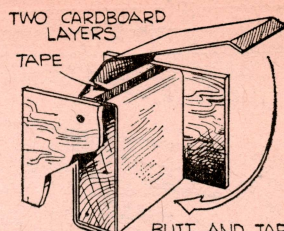


LAMINATION STACK

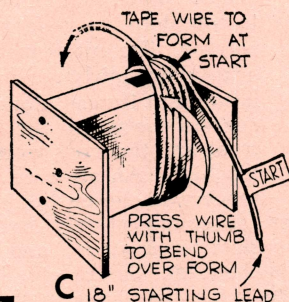
TAKE DIMENSIONS W, X, Y, Z FROM PREPARED LAMINATION STACK; X TIMES Y MUST BE 8 TO 10 SQ. INCHES



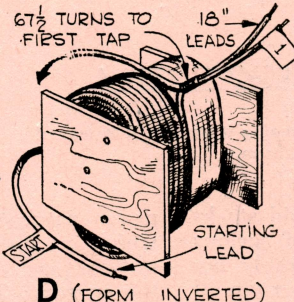
A COIL FORM



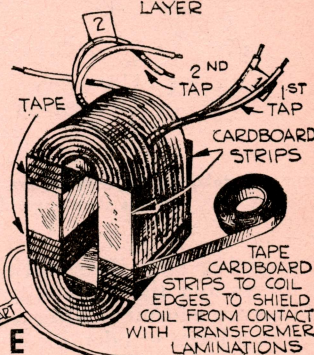
B SECOND CARDBOARD LAYER OPPOSITE FIRST LAYER



C 18" STARTING LEAD



D (FORM INVERTED)



E

4

STEPS IN WINDING THE TRANSFORMER

and taping as before. Then continue the winding until you have added 27 turns. This finishes the coil.

Now with the coil still on the winding block, give the coil a good soaking coat of insulating varnish (black or clear) or spar varnish. Try to get good penetration, thinning the varnish if necessary, and allow the coil to drain and dry overnight. Remove the end plates and, while supporting the edges of the coil with the other hand, tap the coil winding block out of the coil with a small hammer.

Assembling the Transformer.

Prepare four strips of heavy paper about calling-card thickness (Fig. 4E). Tape these to the edges of the coil where the laminations will butt against the core, as insurance against coil-to-core shorts. Then set the coil on end on a clean rag and start assembly by inserting a stack of six "E" laminations in the coil, first from one side and then from the other, interleaving until all of the "E" laminations have been inserted. Now insert the "I" laminations to fill the gaps.

If your laminations are not all the same thickness, use those from one transformer at one end of the new core, and those from the sec-

MATERIALS LIST—ARC WELDER

Amt. Req'd	Size and Description	Use
1	*6 volt fast battery charger, any condition	
1	extra transformer, same type as charger	
1	electrode holder (welding supply store)	welding cable
12 lb. (or 300 ft.)	†No. 9 magnet wire, either D.C.C., D.C.C. Enamel, Enamel, Nyclad, or Formvar	transformer
13	1/4-20 x 1 1/2" rh brass machine screws with lock washers, and brass nuts	taps
26	1/4" plain brass washers	taps
25	#8/12 solder lugs (Western Auto Stores)	taps
36 in..	3/16" mild steel rod	transformer
12 each	3/16-24 nuts, plain washers, and lock washers	transformer
2	1/4-20 brass wing nuts	cables
10	6-32 x 1/2" machine screws, nuts, and lock washers	panels
4	#10 x 2" rh woodscrews	reactor
1	1/4 x 3 x 6" hardboard	panel
1	1/4 x 3 x 12" hardboard	panel
3	1/4 x 5 1/2" dia. plywood or hardboard discs	reactor
8	1/4 x 3/4 x 12" pine strips	reactor
1	3/16 x 12" wood dowel	reactor
1	Neon indicator lamp—53E395, type NE51H; and socket—53E142, type 931H (Allied Radio, 100 N. Western Ave., Chicago)	indicator
4 ft.	#14 fixture wire	fan and supply line
1	AC terminal block (3 terminal)	indicator
1	plug and receptacle (3 conductor)	
1	3-conductor extension cord, #14 wire —machine enamel, waterproof glue, insulating (or spar) varnish, solder, friction tape, #18 x 3/4" nails, cardboard	

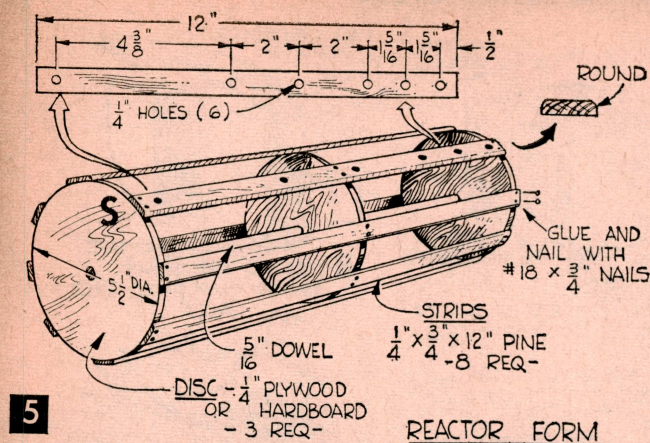
* Should include following parts: transformer, fan, cables, battery clamps, cabinet.

† Following items available from Master Mechanics Manufacturing Co., Burlington, Wis.:

A ... 12 lbs. #9 Formvar magnet wire	\$11.40
B ... 20 ft. welding cable, 100 ampere	6.00
C ... 20 ft. #14 three-conductor flexible cable	2.95
D ... electrode holder	3.75
E ... welding helmet	3.25

Note: Items A, B, C, if ordered at same time

All prices F.O.B. Burlington, Wisconsin



The reactor coil stabilizes the welding arc, keeping it steady. It is wound on this simple wooden form.

ond at the other end. This will avoid stacking problems and the possibility of serious losses in the transformer. After assembly, lay the core on a large wooden block and tap all four sides of the core alternately to square it up and close the air gaps between the "E's" and "I's".

New bolts must be made to clamp the core because of its increased thickness. We used $\frac{3}{16}$ -in. mild steel gas welding rod, threading each end with a 10-32 die for about 1 in. Next, place the original mounting straps back on the core and tighten the assembly slightly. Then place the core back on the block and tap all four sides to insure minimum air gap between the "E's" and "I's". Finally, draw the bolts down tightly, compressing the core. Tighten them equally to keep the core as square as possible.

Mounting the Transformer. Make a template of cardboard from the new transformer mounting holes, transfer the layout to the bottom of the cabinet and drill the mounting holes. But before mounting the transformer, an insulated panel for the two voltage taps must be made and installed on the front of the cart. A piece of $\frac{1}{4}$ -in. stock, either plywood or tempered hardboard, cut to 3 x 6-in. size may be used. Drill the panel for two terminal holes with a $\frac{1}{4}$ -in. drill. Secure the panel to the cart with four 6-32 machine screws and nuts or self tapping screws. Then drill the terminal holes through the metal cabinet using the previously drilled panel holes as a guide. Remove the panel and enlarge the terminal holes in the cabinet to at least 1-in. diameter with a radio chassis punch or hole saw.

Place the Transformer in the cart and wire it to the panel by cutting the tap leads to the proper length and fitting them with terminal lugs, soldered on with rosin core solder. Make up the terminals according to Fig. 3, fit the

double tap leads to them, and push them through the panel from the inside. Secure with a plain washer and nut drawn up snugly. Reinstall the fan, line cord, and ac junction block, then finish up the wiring connections for these parts, following Figs. 3 and 6. Connect the fan and neon indicator light with a smaller wire, such as #14.

One more part is needed to complete the welder: the reactor. The autotransformer used has fairly good regulation, but if used alone, the current between the electrode and the work would be too high. An air core reactance was chosen because it

never saturates, is comparatively light in weight, is the easiest to construct, and—last but not least—is cheapest. The reactor limits the current: The more reactance in the circuit, the less current flow. In the welder the reactor is wired in series with one of the welding cables, and is tapped to permit varying the reactance to change the current.

To Construct the Reactor, start by cutting three $5\frac{1}{2}$ -in.-diameter discs from plywood or hardboard and the $\frac{1}{4} \times \frac{3}{4} \times 12$ -in. strips (Fig. 5). Glue the discs to the center and ends of a $\frac{3}{16}$ -in. diameter by 12-in. dowel. Round the edges of each strip, on one side only, then glue and nail them around the edges of the discs with equal spacing. Use #18 x $\frac{3}{4}$ -in. nails and keep the rounded edges of the strips outward. Drill six $\frac{1}{4}$ -in. holes in one strip as shown in Fig. 5. Insert brass machine screws in the holes for the reactor taps.

Next, to wind the reactor, start at the "S" end of the form, bare $\frac{3}{4}$ in. of the #9 wire, make an eye in it, and secure it to the first brass screw. Wind 25 turns, evenly spaced, to the second screw. Cut off, bare the wire, make an eye in it at this point, and secure it. This completes the first section of the reactor. Make the second section, ten turns, in the same manner, starting with an eye on the second screw and ending with an eye on the third screw. Wind the third, fourth, and fifth sections similarly, of ten, five, and five turns, respectively.

Secure the eyes at each screw with a washer and nut. Take care to distribute the wire evenly between the screws, as this will give a little space between turns and help cooling. The wire must be tightly attached to the strips. Otherwise, during heavy current flow they will move violently on the form, and may shake the insulation loose. Fasten the coil to the wooden strips with several heavy varnish coats, allowing the var-

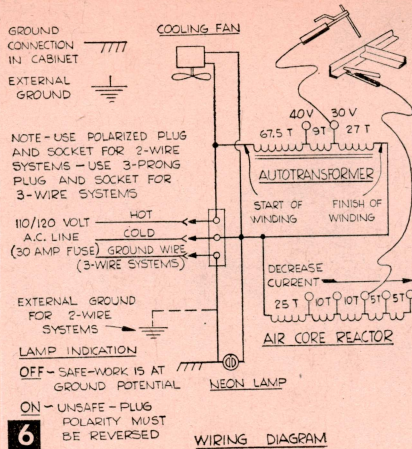
nish to dry between coats. Work the varnish down between the wires with the brush to make sure the varnish adheres to the wood strip.

Mount the Reactor above the fan and just below the ventilating louvers where the airstream will cool it. Use a wooden spacer, if needed, at each end of the reactor to center it in the cabinet. Drill holes through the cabinet and spacers and, using round-head wood screws of sufficient length, secure the reactor in place. Make a 3 x 12-in. panel for the reactor taps (Fig. 3) and mount it above the transformer panel on the front of the cabinet. Following Fig. 6, wire the starting end of the reactor with #9 wire to the terminal block, then make up and connect the five reactor tap wires (Fig. 3). Use terminal lugs on all these wires.

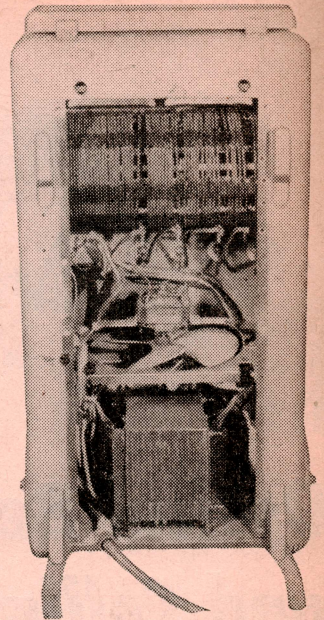
Use a three-wire cord with a three-prong plug for the ac supply to the welder. Note that the neon indicator gives warning by lighting up when the hot side of the line has been connected to the wrong end of the transformer and is *not* lit when the welder is correctly connected. You can, if you wish, use a two-wire supply line, but you must be sure that the two-prong plug is correctly inserted, with the hot side of the line going to the start of the transformer. The neon light will show this, providing it is grounded according to the diagram. If you use a two-wire supply, fit it with a polarized plug and socket, and observe the grounding precautions given in Fig. 6. Fuse the line for not more than 30 amperes.

To Strike the Arc, do not jab the electrode at the work; rather, draw it slowly across it as if you were striking a match. While scratching, lift the electrode about $\frac{1}{8}$ in. to establish the arc. The arc should be short, about $\frac{1}{16}$ – $\frac{1}{8}$ in. long. A good arc has a crackling sound and does not hiss or blow. Another important item is the electrode. A good rod, especially for the non-professional, is Lincoln Electric Company's *Fleetweld*. When buying electrode (rod) be sure to specify ac type; dc rod will not work.

The key to any kind of welding is practice. You will have to experiment to get the correct heats for stock thickness and electrode size.



Right, Back view of the completed conversion (rear panel removed) shows relative position of the reactor, fan, and transformer. If you use some other cabinet, try to get an equally effective arrangement for efficient cooling.



Here's a table to help you get started:

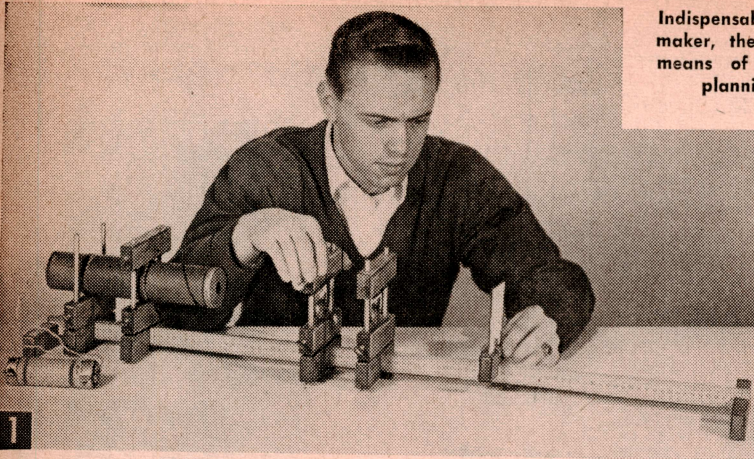
Material	Electrode size	Reactor turns	Trans. V.
auto body stock	$\frac{1}{16}$ in.	55	30
conduit	$\frac{1}{16}$ in. or $\frac{3}{32}$ in.	55 or 45	30
$\frac{1}{8}$ in. steel	$\frac{3}{32}$ in.	25	30
$\frac{1}{4}$ in. steel	$\frac{1}{8}$ in.	25	40
$\frac{5}{16}$ in. steel	$\frac{1}{8}$ in.	25	40

When using the welder, always protect yourself from the direct rays of the arc with gloves, long sleeved shirt, and a helmet fitted with a proper glass. (No. 8 is about right.) Never watch an arc with unprotected eyes, and never permit anyone else to. Powerful actinic rays generated in the arc can damage vision or produce severe sunburn.

● Craft Print No. 338 in enlarged size for building the arc welder is available at \$2. Order by print number. To avoid possible loss of coin or currency in the mail, we suggest you remit by check or money order (no CODs or stamps) to Craft Print Div., SCIENCE and MECHANICS, 505 Park Ave., New York 22, N. Y. Please allow three to four weeks for delivery. Special quantity discount! If you order two or more craft prints (this or any other print), you may deduct 25¢ from the regular price of each print. Hence, for two prints, deduct 50¢; three prints, subtract 75¢, etc. Now available, our new illustrated catalog of 212 do-it-yourself plans, 25¢ (refundable, first order).

Used Carbon Paper Makes Layout Dye

● Don't throw away that worn-out carbon paper without using it to make up a supply of inexpensive layout dye. Crumple a few sheets of the carbon paper in a small screw-top jar. Then add two ounces of denatured alcohol and a half teaspoonful of shellac. Lightly tamp the carbon paper at the bottom of the jar to squeeze out the dissolved dye. Test the dye on bright metal and add more carbon paper to get the desired shade.



Indispensable for the amateur telescope maker, the optical bench provides the means of finding focal lengths and planning various lens systems.

that can be built for about \$5.

The optical bench is designed to line up and firmly hold lenses, mirrors, and screens, and to permit direct readings in either inches or millimeters between optical elements. The collimator provides a source of light, the equivalent of an infinitely distant target.

Optical Bench and Collimator

Use it for:

- Measuring focal lengths of lenses, singly or in combination
- Designing projectors, binoculars, and terrestrial or astronomical telescopes

By TOM DART

TESTING and checking optical systems, especially those that consist of several lenses, can be done easily and accurately with this optical bench and collimator unit

Building the Optical Bench. The backbone of the bench is a meter-stick or ruler, marked both in inches and centimeters for direct reading of lens distances. Make two end blocks of pine, $\frac{3}{4} \times 1\frac{3}{8} \times 6$ in. (Fig. 3A), notched to fit snugly over the stick, and attach them with #4 x $1\frac{1}{4}$ -in. flat head wood-screws.

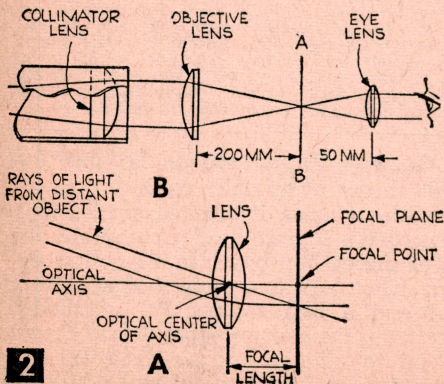
To support different lenses make four (or more) lens holders of the $\frac{3}{4} \times 1\frac{3}{8}$ -in. pine, following Fig. 3B. Note the headless brad driven into the end of one of the slide blocks to retain the slide assembly on the meter stick. Sandpaper all wooden parts smooth, stain them, then wipe the stain off. When dry, finish them with furniture wax.

The two slide blocks are held together by means of a 4-in.-long steel strip (available in many 10¢ stores), secured with two #6 x $\frac{3}{4}$ -in. *fh* woodscrews in the two inner holes. Drill out the two outer holes to take the $\frac{1}{4}$ -in. dowel posts, and glue the posts in place. When assembling the sides, try to get a good sliding fit on the meter stick between the inner faces of the slide blocks. Gluing liners made of construction paper (available at art stores) to these faces will help to get a cushioned sliding fit.

Lens Blocks. Note that the holes in the ends of the blocks are $\frac{5}{16}$ in., to give a free fit over the $\frac{1}{4}$ -in. posts. Drill and tap a 10-24 hole in one end of each lens block to take a 10-24 thumbscrew, to clamp the blocks at the desired height on the posts. Note the notch and groove to hold lenses.

Next are the screen holder (Fig. 3C) and the mirror holder (Fig. 3D). The clips on the screen holder should have a slight spring effect, to be capable of holding a $\frac{1}{16}$ -in.-thick cardboard, or plain glass or frosted glass screens.

The mirror holder block is the same size as the screen holder block. The notches in



these two, incidentally, can also be lined with the construction paper for a cushioned sliding fit.

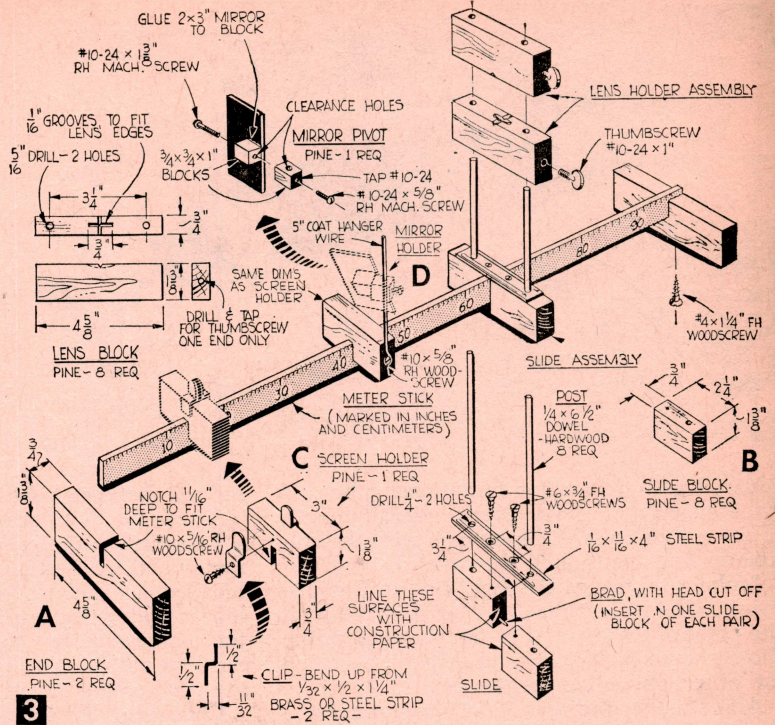
Two small blocks make up the pivoted mirror mount (Fig. 3D). One of these is clamped to the wire post, the other carries the mirror and is pivoted to the first.

The Collimator. Although any tubing that will meet the requirements can be utilized for the collimator (Fig. 5), the cardboard mailing tube used was purchased from Eugene Dietzgen Co. (see Materials List) and was intended for filing and mailing blueprints. This tube consists of a 31-in.-long, 2-in.-I.D. x 1/16-in.-wall tube with a cardboard end-cover, and a 4-in.-long end-tube with cover that makes a sliding fit over the main tube.

Remove the end covers from the tubes with a knife blade without distorting them. Cut a 5/8-in. hole in the center of the small one for wire leads to the bulb and for ventilation. Paint the 4-in.-long end-tube flat black inside, and use it for the coupling tube (Fig. 5). Cut 3/4-in.-long and 6 3/8-in.-long pieces from the main tube for the light source tube and the collimator tube. The light source tube does not have to be painted inside, because it will be filled with spacers, but the collimator tube must be painted flat black inside or lined with black construction paper.

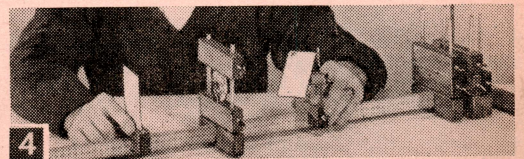
All spacers and sleeves are made from the 2-in.-I.D. x 1/16-in.-wall tubing by cutting, splitting, and fitting into position, then securing with cellulose tape. Paint the spacers and reticle sleeve flat black inside. Line the spacer nearest the reflector with aluminum foil to improve reflection. Paint the edge of the collimator lens flat black to prevent reflection glare.

Reflector. The reflector disk (Fig. 5) is made from 1/16-in. cardboard, 1 7/8-in. diameter, and has a 5/8-in. center hole cut out to fit tightly over the reflector base to which it is glued. Cut several small holes in the disk to provide bulb ventilation. Glue the reflector disk, with reflector attached, to the reflector spacer. This should place the bulb filament 2 1/4 in. from the centerline between the two

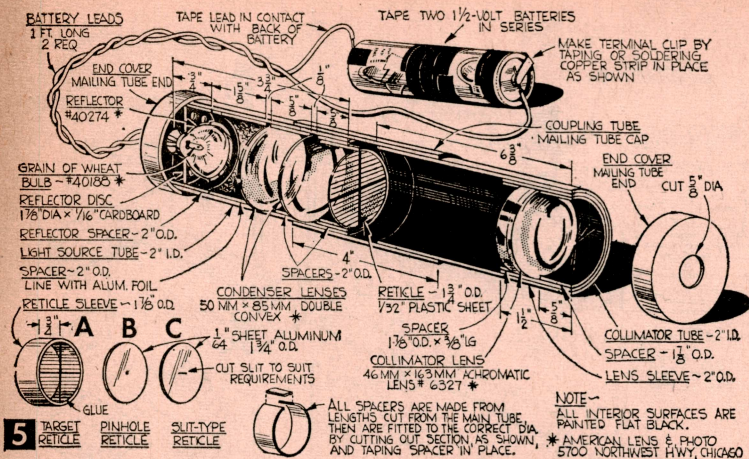


condensing lenses. Solder wire leads to the bulb socket terminals in the reflector and, when in use, connect with two 1 1/2-volt flashlight batteries hooked in series to give 3 volts.

The Condensing Lenses can be plano-convex, unsymmetrical-convex, or double convex. The greater curvature of each lens should face the other. Since these lenses are 50 mm in diameter, they may not fit easily into the 2-in.-I.D. tubing if it is slightly under-size. If this is the case the tube I.D. must be increased by lightly sandpapering it. Make the reflector spacer and the reticle sleeve a sliding fit so that bulbs and and reticles can be removed for replacement. All other spacers and sleeves must be a tight fit or be spot-glued in place for easy removal if necessary. Wax the outside cardboard surfaces of the collimator or stain them with brown shoe polish. If desired, the coupling tube can be



Use a beam of sunlight (or light from any distant source) to measure focal lengths.



covered with decorative imitation leather. If built exactly as shown here, overall length of the collimator will be 10 $\frac{5}{8}$ in. with the collimator lens focused on the reticle.

Make a target reticle according to Fig. 5A, using 1/32-in. clear plastic sheet grooved with the point of a sharp knife. Other reticles, like those shown in Fig. 5B and 5C, can be made for other optical experiments.

Adjustment and Use. To understand the function of a collimator, look at Fig. 2A. Rays of light coming from a distant object, such as the Sun, are practically parallel as they

enter the lens. After refraction by the lens, the rays come together and form an image on the focal plane (AB). The distance from the optical center of the lens to the focal plane is the focal length.

If a target reticle (Fig. 4A) is located at a distance from the collimator lens equal to the lens's focal length, all rays coming from any point on the reticle will leave the lens parallel and will appear to an observer to have originated at an

infinite distance behind the lens.

Therefore, if a lens system such as that of a telescope is optically aligned with a collimator and focused on the reticle pattern, the lens system will be focused for infinity. The lenses under test can be at any distance from the collimator, but the greater the distance, the less will be the light intensity, therefore the weaker the image.

Checking. To check the collimator setting set it up with double convex lens of known focal length in the optical bench. Connect the light source and set up the screen holder with screen behind the test lens. Move the screen until the reticle image is sharp. The distance between the test lens optical center and the screen can be determined from the meter-stick graduations and should equal the focal length of the test lens. If the focal length appears to be longer or shorter than that known to be correct, adjust the collimator length until your test yields the correct value. Then seal the coupling tube to the collimator with cellulose tape, or mark the tubes so they can always be properly set.

In Fig. 2B a simple telescope consisting of an objective lens and an eye lens is mounted with the collimator on the optical bench. Focal length of these lenses is determined as previously described. With the lenses set up as shown, the eye will see the sharpest reticle image when the spacing is as shown, and magnifications will be 200/50 or 4x.

Adjustable Height Stool

- An adjustable stool which you will find useful for many jobs in the workshop or on the farm can be made from an old screw-type jack. Simply weld the base to a discarded brake drum and bolt a smoothly-sanded round wooden seat to top of jack. Operate the jack to give the seat a height range of 6 to 12 in.—L. H. Houck.

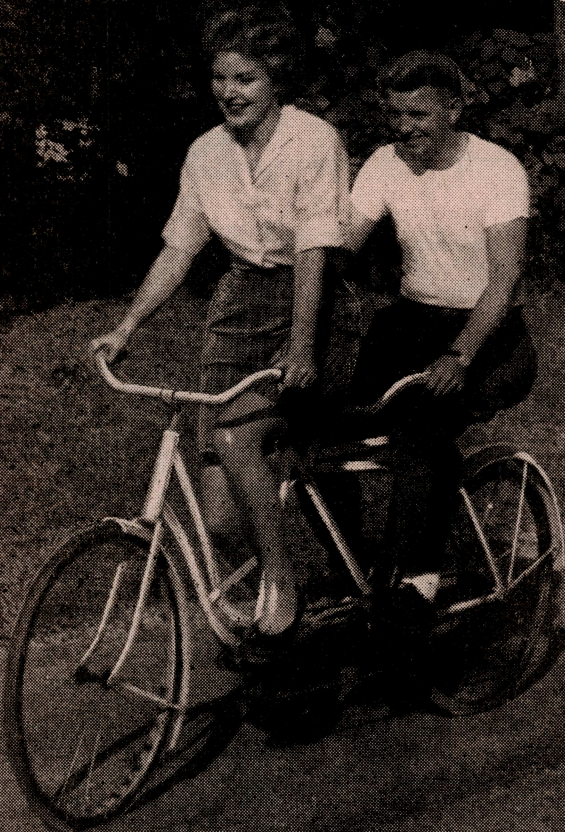
MATERIALS LIST—OPTICAL BENCH AND COLLIMATOR

No. Req.	Size and Description	Use
1	$\frac{5}{16}$ x 1" x 1 meter hardwood rule (* Am. Lens & Photo \$.90)	backbone
1	$\frac{3}{4}$ x $1\frac{3}{8}$ " x 7' white pine	holders and end blocks
1	$1\frac{1}{16}$ x $\frac{1}{16}$ x 17" metal strip (10¢ store, 'drilled' \$.30)	lens holder slides
2	$\frac{1}{4}$ x 3' long hardwood dowel	lens holder posts
8	#10-24 x 1" thumbscrews	lens holders
8	#6 x $\frac{3}{4}$ " rh woodscrews	lens holder slides
8	#4 x $\frac{1}{4}$ " rh woodscrews	end blocks
2	#10 x $\frac{5}{16}$ " rh woodscrews	screen holder
4	#10 x $\frac{5}{8}$ " rh woodscrews	mirror holder
1	#10-24 x $1\frac{3}{8}$ " rh machine screw	mirror holder
1	#10-24 x $\frac{5}{8}$ " rh machine screw	mirror holder
1	5' long coat hanger wire	mirror holder
1	3 x 2" mirror (lady's compact)	mirror holder
1	$\frac{1}{2}$ x $\frac{1}{32}$ " metal strip 4" long	screen holder
1	2" I.D. x $\frac{1}{16}$ x 31" mailing tube with end (+ Dietzgen #4228A \$.30)	collimator tubes and spacers
1	reflector (* A.L.&P. #40274 \$.50)	light reflector
1	grain of wheat bulb (* A.L.&P. #40188 \$.50)	light source
2	50 mm x 85 mm double convex lenses (* A.L.&P. \$.30)	condenser lenses
1	46 mm x 163 mm achromatic lens (* A.L.&P. #6327 \$1.00)	collimator lens
2	flashlight batteries	light source
Misc.	sandpaper, stain, hard polishing wax, flat black paint, flat black construction paper, household cement, small brads, lamp wire, aluminum foil, etc.	

+ Eugene Dietzgen Co., 2425 N. Sheffield, Chicago, Ill.

* American Lens & Photo Co., 5700 Northwest Hwy., Chicago, Ill.

Tandem Bicycle



1

Building a tandem guarantees you'll get outdoors this summer for plenty of healthful exercise that's lots of fun. Only the front handlebars steer, but both pedals control the coaster brake of this easy-handling, showy bike.

Put more fun and healthful zip into your family living with this bicycle built for two

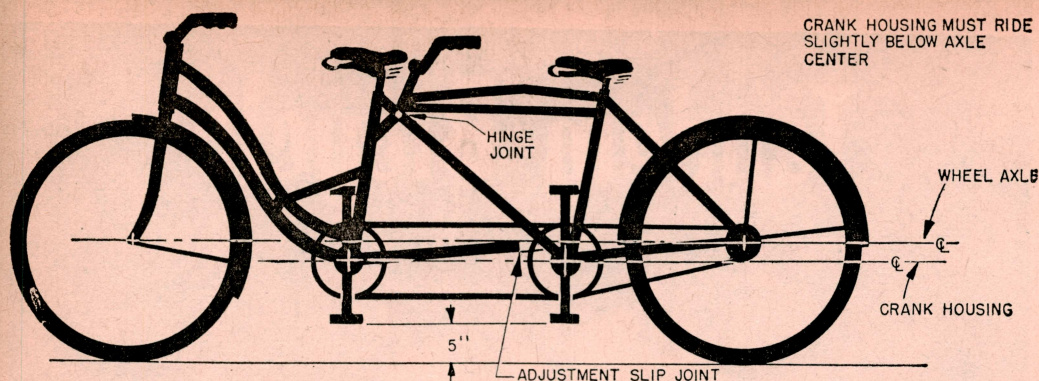
By HAROLD P. SMITH

EVERYONE in your family will enjoy taking part in the popular revival of this gay-nineties sport—riding a tandem; instead of spending \$150, you can build it from salvaged bikes and a few dollars' worth of extra parts.

As you begin this project, you will find that there is no shortage of used bikes and parts. Not only garages and basements but junk yards are rich sources. Often, bikes are discarded after only

minor damage has occurred, and you can buy them for a few dollars. And of course, new stock parts are readily available from cycle shops and mail-order houses.

Construction does not require an over-elaborate shop. Every step, except the welding of five joints, can be done with a hacksaw, a vise, hand tools, and an electric drill. The welds are easily done with a light-duty home welder, or you can



2 FRAME SPACING ADJUSTMENT

saw the parts to fit, and take them to a neighborhood garage, or metal shop, where the work should cost no more than a few dollars. The extra metal joints and parts are sawed, for simplicity, from one 3-ft. length of $\frac{1}{8}$ x $1\frac{1}{2}$ -in. steel flat stock, available in many hardware stores.

You will need two bike frames, a woman's drop frame bike for the front portion, and a man's diamond frame bike for the rear, to build the tandem as shown in Fig. 1. The drop frame is suggested for the front, because it permits a rider to get on without the difficulty of lifting a leg over the extra handlebars in the rear. Select two bikes as alike as possible. They must have the same size wheels, and sprockets, and ought to be the same make and vintage so the parts will match. It would be best to choose American made bikes, since foreign makes are more scarce, and the parts more costly and harder to find.

As shown in Fig. 3, drive sprockets 1 and 2 must be equal in size, and you will need an extra one as well as another drive chain. If these paired drive sprockets were different diameters, one crank would revolve faster than the other, making it impossible to synchronize pedaling. It also could cause one rider to toe the road during sharp turns. While the drawing shows sprocket 3 equal in size to 2, you can use a larger or smaller sprocket in its place to obtain more or less speed, with the corresponding change in torque.

Start construction by stripping the two bike frames completely. If you haven't worked before on bikes, it would be a good idea to tag the parts and to take careful note of how they fit together. Also, this is a good time to check the bearings for dirt and wear, and all other moving parts for damage, so you can pick up any needed replacements.

The front wheel fork of the man's bike will not be used. With a hacksaw, cut the head (the short tube into which the front wheel fork swivels) off, as close as you can, to avoid shortening the tubes.

Then, if your bike has the usual two top tubes, carefully bend the top one down against the second one (Fig. 3A). Heat the tube with a blowtorch to redness at the bending point. Now, the

MATERIALS LIST—TANDEM BICYCLE

No. Req'd	Description
1	man's bike, full size 26" complete
1	woman's bike, full size 26" complete except for wheels*
1	extra drive sprocket, & drive chain to match above
1	3' length, $1\frac{1}{2}$ x $\frac{1}{8}$ " cold rolled (#1018) flat steel (sometimes called steel strap metal)
1	$\frac{3}{8}$ " x 24 thd. x $2\frac{1}{2}$ " hex head steel cap screw & nut
2	$\frac{3}{8}$ " x 24 thd. x 2" hex head steel cap screw & nuts
1	$\frac{3}{8}$ " x 24 thd. x $\frac{3}{4}$ " hex head steel cap screw & nut
1	$\frac{1}{4}$ " x 28 thd. x $2\frac{1}{2}$ " hex head steel cap screw & nut
2	$\frac{1}{4}$ " x 20 thd. x $1\frac{1}{2}$ " rh stove bolts & nuts

* see text for note on shallow spring front saddle.

sawed ends of the three tubes should be approximately even. To keep moisture out, seal the open tube ends by welding on steel washers, such as knockout discs from electrical boxes.

The two bike frames are adjustably hinged together by means of a joint and king bolt (see Fig. 4), which will permit you to take up slack in the front chain as it wears and stretches in use. The hinge joint for the rear bike frame is made from two pieces of steel flat stock with corners rounded. Weld these pieces to the three tubes as in Fig. 3B, to form an open-front channel about 1 in. deep and 1 in. wide. When the welding is finished, drill a $\frac{3}{8}$ -in. hole for the bolt on the center line of the bottom diagonal tube, through both plates.

Figure 3A shows what to saw away from the frame of the woman's bike used up front. Keep the bottom chain stays as long as possible by sawing them off close to the original rear axle slots. Saw the diagonal back stays off about $2\frac{1}{2}$ in. down from the seat tube, keeping intact whatever fitting is used at this point for tightening the seat post in place. An optional brace can be welded diagonally to strengthen the bottom portion of the woman's bike frame.

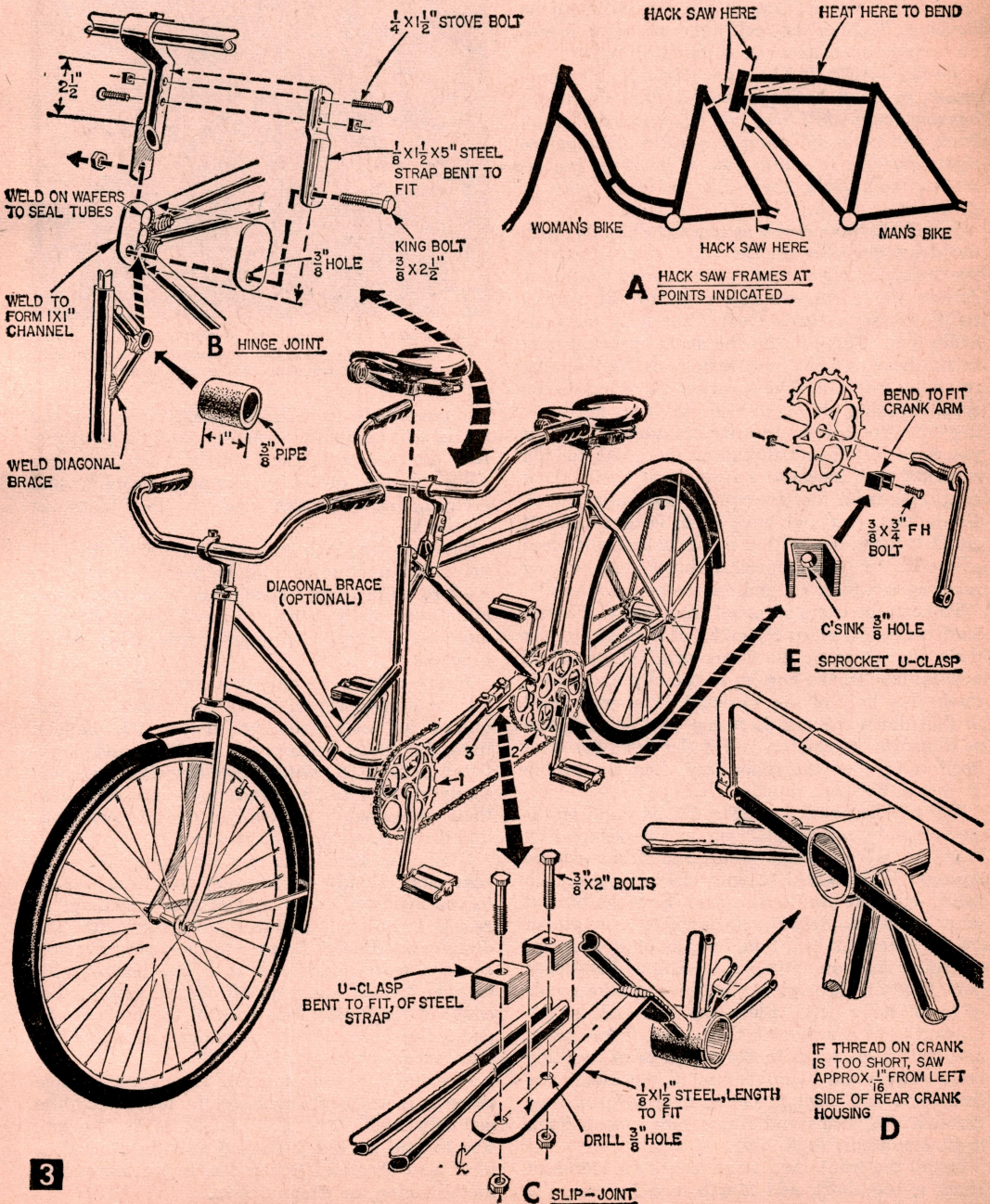
Next make the fitting (Fig. 3B) which meshes with the plates you added to the man's frame, by welding a 1-in. piece of $\frac{3}{8}$ -in. pipe at a right angle to the frame. The diagonal brace is a piece of the discarded backstay tubing welded as a triangular strut. Since the welding heat could roughen the inside of the seat tube, spoiling the fit, it is suggested that you put an old seat post, or piece of

$\frac{13}{16}$ -in. bar stock inside, during the welding, to carry away excess heat.

A slip joint plate is now needed to complete the front chain adjustment. Make it to fit from the $\frac{1}{8}$ x $1\frac{1}{2}$ -in. steel flat stock according to Fig. 3C. Drill the $\frac{3}{8}$ -in. holes in the plate and in the clasps and bolt the assembly to the bottom chain stays.

Now, you are ready to set up the assembly of

the two frames. Reinstall the front fork in the forward frame. Hinge the two frames together with the kingbolt and lay them flat on the floor. With a 6-ft. straightedge, align the frames so their crank housings will come slightly below a straight line running between the front and rear axles. (Fig. 2). Positioning should be such that the revolving pedals clear the ground by about 5 in. Otherwise, if the barrels ride too high, the



overall tandem height is unduly increased. Move your slip joint plate into contact with the diagonal tube of the rear frame, tighten the U clasps down, check the alignment and weld the plate to the tube. Make a strong weld since it will bear much of the weight of the riders.

Reassemble the bike parts, beginning with the front crank, which must be reversed in its barrel, with the drive sprocket on the left side of the frame. Use #3 cup grease on the bearings, and check them for flaws and dirt. The assembly should turn freely, but should not shake in its housing. Tighten the lock nut well, since it will be turning opposite to its original direction.

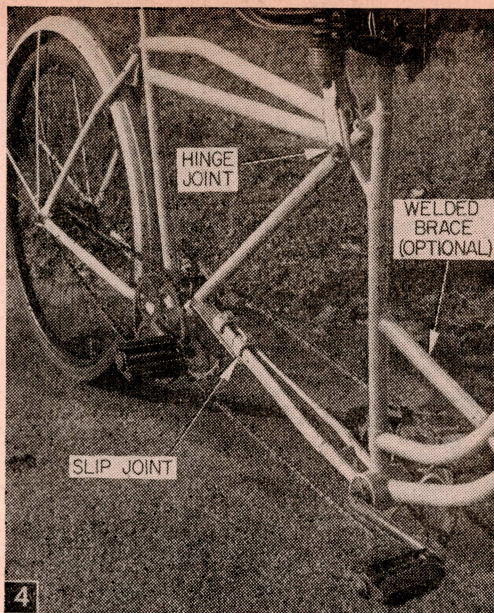
IMPORTANT NOTE: When adjusting bike hub, crank, or head bearings, first tighten down the bearing cones until they just begin to bind. Then back one cone off about a quarter turn before tightening the retaining nut. If bearings are installed too tightly, they will freeze, or may be damaged.

Install the rear crank as it was originally, with the drive sprocket on the right side. Clean the bearings, making sure they are in good condition. Adjust the crank bearing cone to the proper tightness—so it turns freely, but feels mechanically firm. Then, install the spare sprocket next to the bearing cone, and install and tighten the retaining lock nut. The sprocket may bind on the crank housing. If so, shim it out from the bearing cone so it has clearance to turn freely. If you have insufficient thread on the crank for the retaining nut, hacksaw a ring about $\frac{1}{16}$ -in. thick (Fig. 2D) from the left end of the crank barrel. To do this, you will have to drive out the left crank bearing cup with a hammer and soft piece of wood. In most American bikes, the bearing raceway is a force fit, and can be removed easily.

To keep the extra sprocket from slipping under load, make a U-clasp (Fig. 2E) of steel strap, just wide enough to fit the crank arm snugly. Drill a $\frac{3}{8}$ -in. hole in the bottom of the clip and bolt it to the lug hole of the sprocket. You may need to thin down the nut so it can pass frame parts as the sprocket rotates, and if the extra sprocket itself scrapes on the chain stay, dent the tubing in with a flat nose punch.

The middle handlebar (Fig. 2B) is required for support only, not for steering, and is fastened by brackets which must clear the front saddle springs. Using a saddle with shallow springs in front, will give you more space. Saw the butt of your extra handlebar post down to a length of $2\frac{1}{2}$ in. Then cut two 5-in. lengths of steel strap, clamping one on either side of the handlebar post. Drill all three pieces together to take a pair of $\frac{1}{4}$ -in. stove bolts. Flare the free ends of the bracket to fit snugly over the tandem frame pivot, and drill $\frac{3}{8}$ -in. holes in the straps to fit the king bolt. Adjust the handlebar so it just clears the front seat and springs. Then drill a $\frac{1}{4}$ -in. hole through the straps and frame hinge clasp for a $\frac{1}{4}$ -in. stove bolt (optional).

Install the front chain next. Since the standard chain is too short, add length, and be sure the



Bike frames are hinged by means of a king bolt. The slip joint regulates the distance between cranks, to adjust for chain wear and stretch.

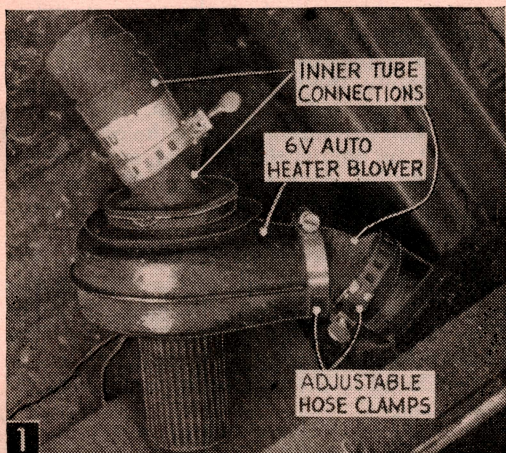
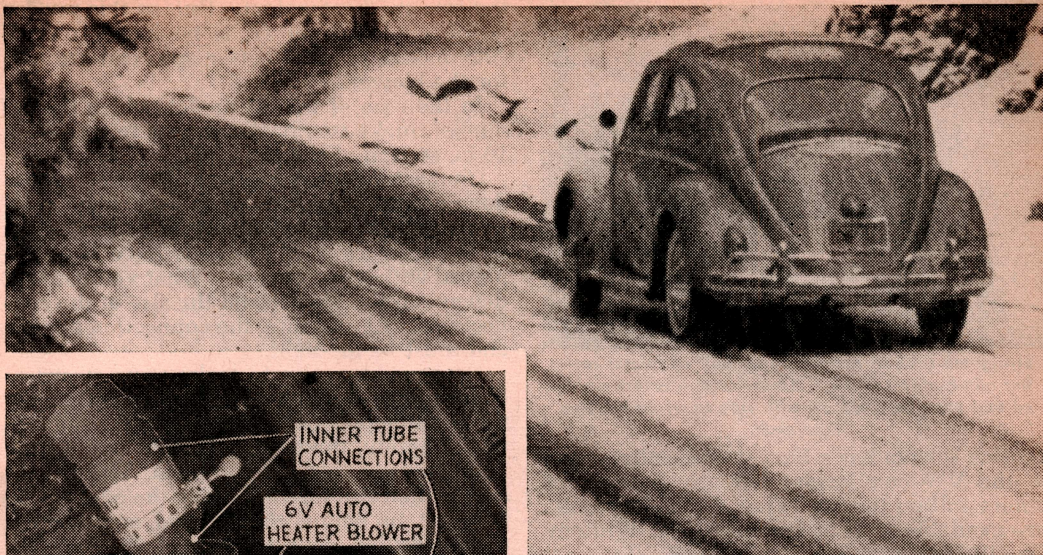
two cranks are in matching positions, so that the riders will be able to synchronize their pedaling. Add the coaster brake, rear chain and all other parts in the ordinary manner, cleaning and greasing all bearings and moving parts as required.

The regular chain guard will work on the rear drive, but for the front chain, you can improvise a guard by bending a straight channel from sheet aluminum, or by using a piece of aluminum edge molding. Fasten the guard with sheet metal brackets.

Because there are only two wheels to carry the weight of two riders, extra tire pressure is required for easy pedaling. If you use balloon tires, they must be in prime condition and be inflated to 30 or 35 pounds. Middleweight tires can safely stand 5 to 10 pounds more pressure than their rating, while lightweight tires in good condition can stand up to 55 pounds.

Riding the tandem is easy for any cyclist. The rear rider should sit relaxed, and lean slightly to the inside of turns, and at first may have to resist a natural impulse to steer with the dummy handlebar. Be sure to coast around sharp corners, with riders' feet in a line horizontally, to keep pedals and toes off the pavement. Because of the longer axle span of the tandem, the pedal clearance on corners is more of a problem than on an ordinary bike.

A stand for your tandem is optional. Since there is more length and weight to balance, the ordinary kick stand may not quite do the job. Try to find an old U-shaped rear axle stand, a kind now obsolete. Otherwise, improvise one of metal tubing, or channel iron.



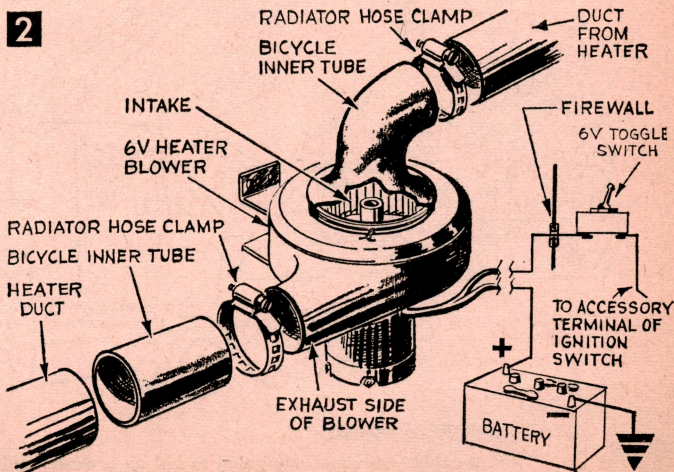
Neatly concealed under the rear seat cushions, powerful booster blower gives VW owners big-car heater performance for cold weather driving comfort.

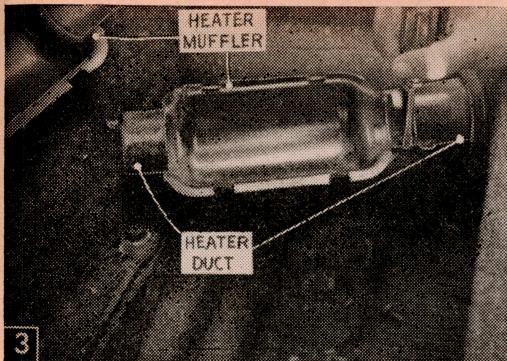
If you've driven your Volkswagen in below-freezing weather, you've surely considered installing a blower to speed up the flow of air from the heater. For less than \$10 and four hours of work, a salvaged, electrically-driven, automobile-type blower can be fitted into the VW's heating system that will, especially while driving in traffic where your engine speed is low, double the output of hot air.

To install the heater-blower, you have to first buy the fan unit (Fig. 1). For this purchase, the nearest auto salvage yard is the easiest on your pocketbook and, as there isn't much that can go wrong with a used blower, the quality is not likely to be less. Be sure, however, that the motor is working before you buy it and, also, that it has a 6- and not a 12-volt motor.

The 1951-54 Nash Airtemp

More Heat from Your Volkswagen





3
Straighten tabs to remove upper half of heater muffler and burlap cartridge. Lower section is tack welded and must be pried off with care to avoid bending duct ends.

heating system has a blower especially suited to the VW conversion, but any number of others will do the job. New 6-v blower units are available at \$4.95 from the J. C. Whitney Co., 1917 Archer Ave., Chicago 16, Ill.

Once you have your blower, remove the rear seat cushion from your car. Now, depending on whether you own a 1961 or an older model VW, you have to use one of two methods of opening the heating duct to take the blower.

If yours is a pre-'61 model, you must remove a small, tank-shaped muffler (Fig. 3) that was originally fitted to silence air rush-

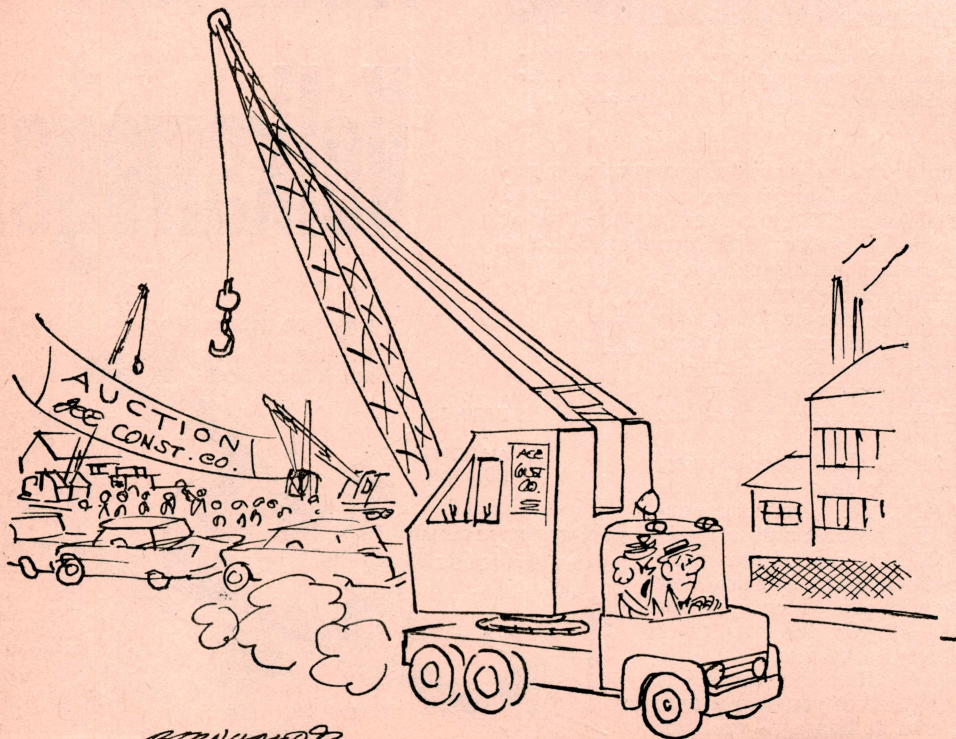
ing into the heater duct. But, as this muffler is fairly ineffectual (it is no longer on the 1961 models), what better spot can we find for the blower?

In the case of the '61 model, which has no muffler, make two hacksaw cuts to remove a 10-in. section of the duct.

Connecting the blower to the duct can be done with pieces of radiator hose, bicycle inner tube, or, for added rigidity, lengths of frozen-juice cans whose ends have been removed with a can opener. What you use will depend on the blower and the size of the connections. At any rate, the connection at each end must be air-tight.

Now you're ready to make your electrical connections, running a hot lead directly from the positive pole of the battery to the fan motor. Happily, the battery is right next to the heat duct and this is no problem. The ground lead is then run forward along the edge of the floor mat, up behind the kickpad, and through a hole drilled near the top of the firewall. Use a rubber bushing here to prevent fraying the wire's insulation.

Next mount a toggle switch under the dashboard at the left side of the steering column. One of the switch terminals accommodates the wire from the motor, while the other is wired through the ignition switch and soldered to the body as a ground.—WARREN PEASE.



"I thought you were only going to bid on a power drill for your workshop."

Woodturning Lathe for Modelmakers and Hobbyists

For the beginning woodworker or for the advanced craftsman who needs an extra lathe for light work, this low-cost "basic" lathe is a valuable and versatile workshop tool

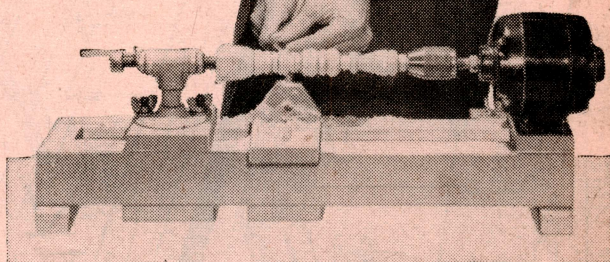
By HAROLD P. STRAND

BUILT almost entirely of wood and a few pipe fittings, with a small electric motor serving as the headstock and power source, this efficient lathe fills the need for light wood-turning in the workshop. Its cost with a surplus or used motor could be as low as \$15 and should not go over \$25.

The motor used by the writer was a 1/20 hp, 110-volt, split-phase type, 1725 rpm, with ball bearings. It was picked up in a place where electronic and radar gear is broken up for salvage. Similar motors are used on office machines and industrial machines and can often be purchased second hand from dealers in used machinery. Our motor has a $\frac{3}{8}$ in. diameter shaft and turns counter-clockwise facing the shaft, which is necessary for our use.

You could use another type or size of motor by modifying the base dimensions on the bed to suit the motor selected. The minimum size that should be considered is 1/20 hp and up to $\frac{1}{8}$ hp could be used if necessary. If the shaft is $\frac{1}{2}$ in. diameter instead of $\frac{3}{8}$ in., you could employ one of the shaft extensions with a $\frac{1}{2}$ -20 threaded end which is sold by Sears for using chucks on motor shafts, and is called a *work arbor*. With a $\frac{3}{8}$ -in. shaft, however, such

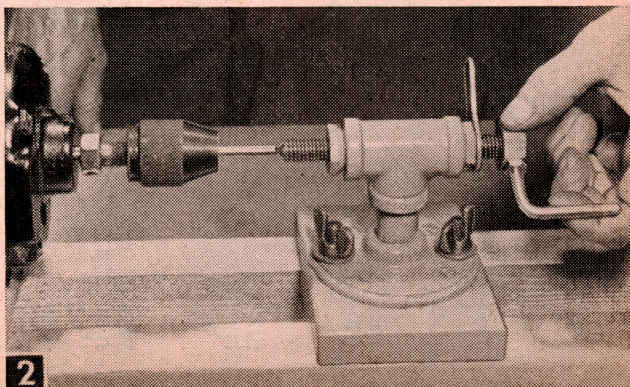
To test alignment of the head and tail stocks, tighten the chuck on a piece of rod having a center hole in it, then run the pointed tail spindle up to it. The point should center exactly on the hole.

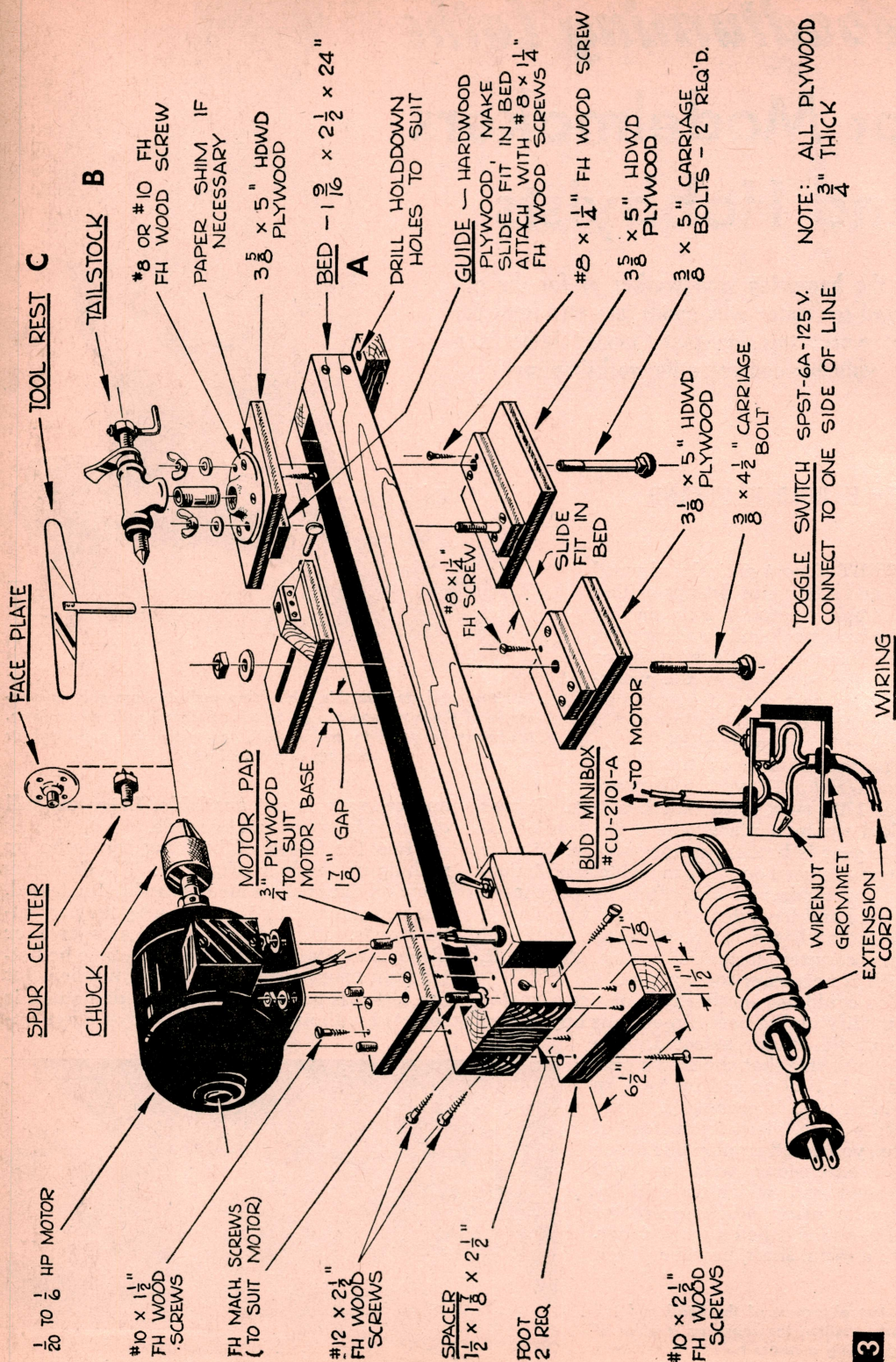


Furniture projects, like this table lamp pedestal, are only one example of the work you can do on this efficient woodworkers lathe. It's handy for polishing and sanding operations, too, and ideal for making ship model parts.

an accessory is not available. Later we will describe how one can be made.

Start the Work of building the lathe by making up the bed (Fig. 3A). The drawings show all dimensions for the model illustrated, but you can modify them to suit your particular needs. If hardwood, such as maple or birch, is available this would of course be better than using ordinary building lumber, but the latter is suitable if smooth, dry stock is selected without excessive knots or other im-





perfections. After cutting the bed rails to size, dress all surfaces true and straight, and sand smooth. The spacing blocks to be fitted in the ends of the two rails should be of exactly the same dimensions so that the resulting slot will be uniform in width at both ends.

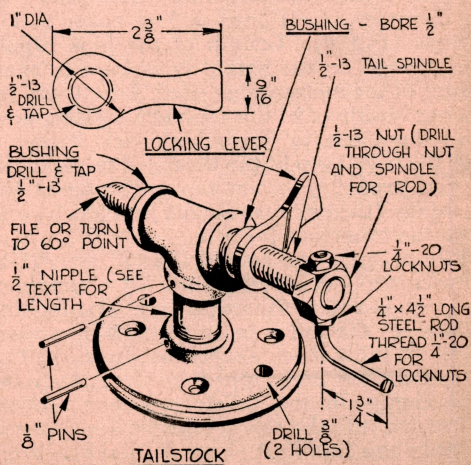
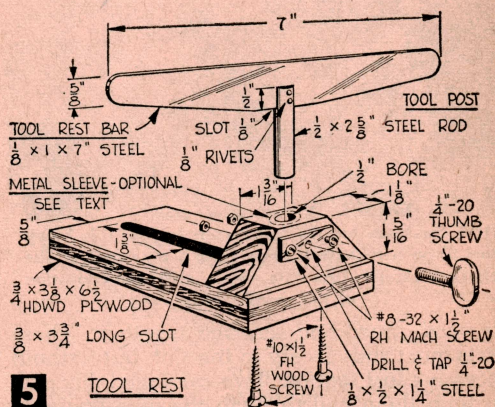
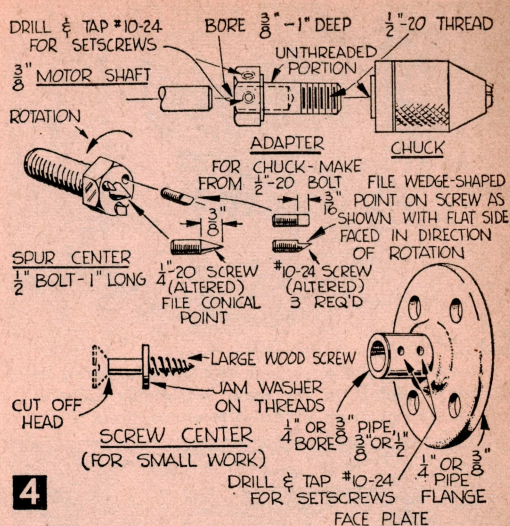
Assemble the rails and spacers with glue and 2½-in. #12 fh (flathead) woodscrews, drilling ⅝₂-in. shank holes and ⅞-in. pilot holes for the screws. Make the feet of hardwood, and attach them with 1½-in. #10 fh woodscrews, drilling ⅜₁₆-in. and ⅝₄-in. shank and pilot holes. Make the motor mount pad of ¾-in. hardwood plywood (Fig. 3) and secure it with 1½-in. #10 fh woodscrews. Four ¼-20 fh machine screws protrude through the pad for attaching the motor. Countersink the heads of all screws.

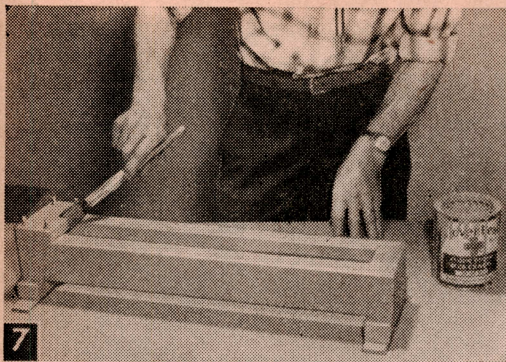
Paint this assembly with aluminum paint, two coats, then paint the *outer* surfaces two coats (Fig. 7) with a machine enamel, if you prefer the appearance of this finish. The *inner* surfaces, where the tool rest and tail stock will slide, are left un-enamelled, as the aluminum paint provides a good slick surface.

Tailstock. Make the upper and lower sections of the tailstock (Fig. 3B) of hardwood

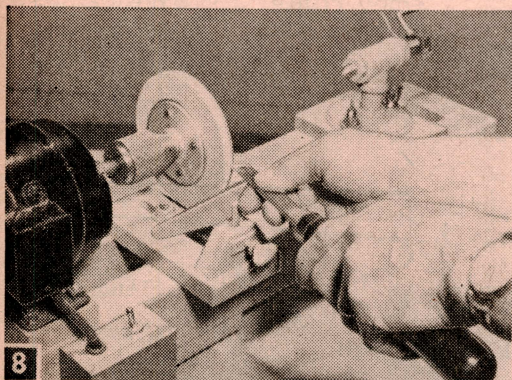
MATERIALS LIST—WOODTURNING LATHE

No.	Req'd	Size and Description	Use
1	1	1 1/16 x 2 1/2 x 54" hardwood (birch or maple)	bed feet, tool rest
1	1	1 1/8 x 1/2 x 18" hardwood	tailstock, tool rest, motor mount
1	1	3/4" x 1 1/2 sq. ft. (approx.) birch plywood	tailstock, tool rest, motor mount
1	1	1/2" floor flange	tailstock
1	1	3/8 or 1/4" floor flange	faceplate
1	1	1/2" pipe tee	tailstock
1	1	1/2 x 1 1/2" (approx.) pipe nipple	tailstock
2	1	1/8 x 1 1/2" brass reducing bushings	tailstock
1	1	1/4 x 4" (approx.) black iron pipe	tool rest, faceplate
1	1	3/8 x 2" (approx.) black iron pipe	faceplate
1	1	1/4" dia. x 4 1/2" cold rolled steel rod	tailstock
1	1	1/2-13 x 5" threaded rod	tailstock
2	3	3/8 x 5" carriage bolts with wing nuts and washers	tailstock
1	1	3/8 x 4 1/2" hammer bolt with hex nut and washer	tool rest
2	1	1/4-20 hex nuts	tailstock
1	1	1/4" lock washer	tailstock
1	1	1/2-13 hex nut	tailstock
1	1	1/8 x 1 x 10" (approx.)	tailstock, tool rest
1	1	1/2" dia. x 2 5/8" steel rod	tool rest
1	1	1/4-20 x 3/4" thumbscrew	tool rest
2	1	1/4 x 2" hex bolt (See text)	chuck adapter, spin center
2	1	8-32 x 1 1/2" rh machine screws with nuts and washers	tool rest
4	1	1/4-20 x 1 1/2" fh machine screws with nuts and washers	motor mount
12	1	1 1/2" x #10 fh woodscrews	
8	1	2 1/2" x #12 fh woodscrews	
14	1	1 1/2" x #8 fh woodscrews	
4	1	3/4" x #8 or #10 fh woodscrews	
1	1	115V., 1724 rpm, split-phase induction motor, 1/20 to 1/6 hp., ballbearing type preferred, counter clockwise rotation facing shaft	
1	1	Bud Minibox CU-2101-A (electronic supply house)	
1	1	SPST 6A125V toggle switch with on-off plate	
7 ft.	2	wire #18 rubber covered extension cord type SJ, with plug	
3	1	1/2" rubber grommets	
3	1	Wirenut solderless connectors	
1	1	Aluminum paint, madrine enamel, glue	
1	1	hand-tightening chuck, threaded 1/2-20	





Following up the base coat of aluminum paint, enamel is applied to the outer non-sliding surfaces. This gives an attractive two-tone effect.



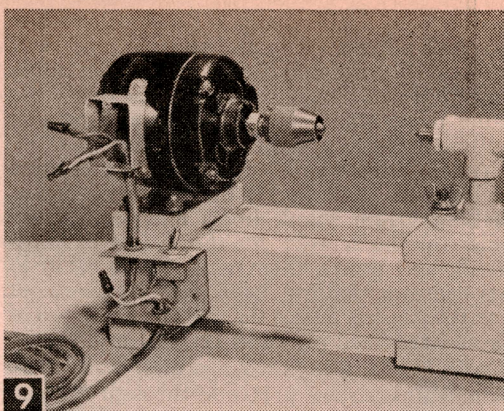
Here the base for the lamp seen in Fig. 1 is being turned on a faceplate made from a pipe flange. The chuck holds the faceplate. Note convenient location of the on-off switch.

plywood, glued and screwed together. These parts must slide freely in the slot, but without excessive lost motion. Two carriage bolts pass through them and through the pipe flange to clamp the tailstock assembly to the lathe bed.

Make up the pipe fittings tightly, and to prevent them from loosening drive pins ($\frac{1}{8}$ -in. diameter steel) into drilled holes in the fittings (Fig. 6). Length of the pipe nipple will depend on the height from base to shaft center of the motor being used. Install the reducing bushings in the tee very tightly, then drill them out to $\frac{27}{64}$ -in. internal diameter. Tap them $\frac{1}{2}$ -13 to fit the threaded tail spindle. If you prefer, you can tap only one of the bushings (the one nearest the headstock) and bore the other out to $\frac{1}{2}$ in.

File or turn one end of the tail spindle to an accurately centered point. Fit a handle of $\frac{1}{4}$ -in. steel rod to the other end. The locking device for the tail spindle consists of a piece of $\frac{1}{8}$ -in. thick steel, shaped as shown in Fig. 6, and drilled and tapped $\frac{1}{2}$ -13. Attach the pipe flange to the tailstock upper section, shimming it to the correct height if necessary.

Make the Tool Rest (Figs. 3C and 5), gluing and screwing the wooden parts together. The tool rest bar, a piece of $\frac{1}{8}$ x 1-in. steel, is



Complete wiring details are seen in this view of the "business end" of the lathe. If your motor comes equipped with a cord, it can be led directly to the switch box, eliminating the terminal box on the motor. The motor must have CCW rotation, facing the shaft. Some motors are reversible by switching leads, some not, so check this before buying.

riveted in a slotted piece of $\frac{1}{2}$ -in. diameter steel rod. This rod, or post, fits in a hole drilled in the tool rest support block. A thumbscrew clamps it in position. This arrangement can be improved somewhat by lining the tool post hole with a piece of steel tubing (or $\frac{3}{8}$ -in. pipe, reamed) that will just receive the $\frac{1}{2}$ -in. diameter tool post (Fig. 5).

Wire the Motor according to Figs. 3 and 9. Use rubber grommets where the wire passes through the motor terminal box and the switch box.

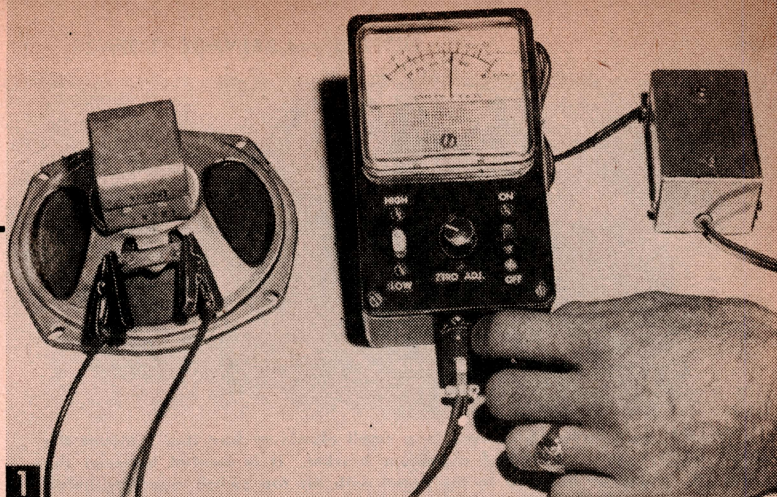
If your motor has a $\frac{1}{2}$ -in. shaft you can use a purchased adapter (or work arbor) for mounting a chuck, but if the shaft is $\frac{3}{8}$ in. you can make an adapter out of a $\frac{1}{2}$ -20 bolt. Bore the head end of the bolt $\frac{3}{8}$ in. (better get someone who has a metal lathe to do this) and drill and tap the head for two setscrews. The chuck will fit on threaded end (Fig. 4A).

With the chuck mounted, you can make a spur center for woodturning out of another $\frac{1}{2}$ -in. bolt (Fig. 4B). Drill and tap the head of the bolt $\frac{1}{4}$ -20 in the center and 8-32 at three points on the head. Insert a $\frac{1}{4}$ -20 screw in the center hole, cut it off, and file it to a point while the spur center is turning. Then insert 8-32 screws tightly in the outer three holes and file wedge-shaped points on them, taking care to face the flat sides of the points according to Fig. 4B.

You Can Make Faceplates out of $\frac{1}{4}$ or $\frac{3}{8}$ -in. pipe flanges, reaming the short lengths of pipe fitted to them to the proper size for your motor shaft (Fig. 4C). Make a screw center for small work out of a wood screw and a washer.

Make a final check on the alignment of the head and tail centers by placing a short piece of rod with a center hole in it in the chuck (Fig. 2). If the tailstock is correctly positioned its point will fit in the center hole.

Low range on most ohmmeters is 0 to 1,000 ohms. This meter gives you dependable readings of low ohmage parts such as this speaker coil. You can calibrate the meter to read even in fractions of an ohm.



Low Range Ohmmeter

Low scale on most ohmmeters is 1,000 ohms. This meter can read down to fractions of one ohm!

By GUS WESENFELD

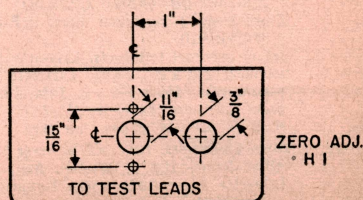
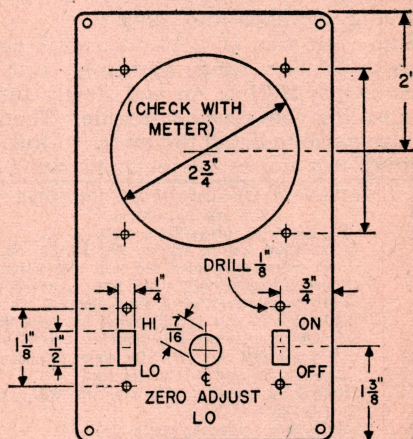
QUITE a few electrical and electronic parts such as ballast resistors, lamp filaments, speaker coils, and extension lines have resistance so low it cannot be read accurately, or at all, on the ordinary volt ohmmeter. This project which priced out at less than \$12 does the job.

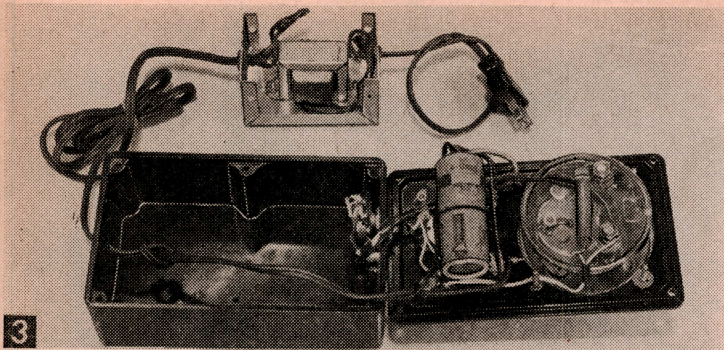
Though the circuit values in the schematic (Fig. 5) provide for a low range scale reading from $\frac{1}{2}$ ohm to 25 ohms, you can easily set up a low range reading from $\frac{1}{10}$ ohm to 2 ohms, or any other similar range. This can be done by lowering the value of R3, explained later.

Cut the Holes in the plastic case panel (Fig. 2) with a fly cutter and drill press, or hand coping saw. Thin spiral blades work best. Before you lay out your holes, check the parts for size. Though a 0-1 milliammeter is shown, you can substitute practically any available milliammeter, even a 0-10 ma. meter.

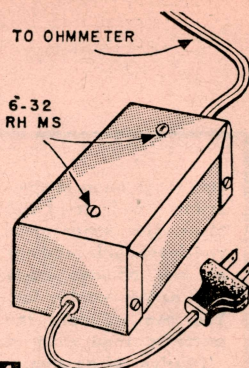
Mount all parts in position, except the meter, safer in its shipping carton until last. Use any thin sheet metal for the chassis. It is held in place by the two upper screws that fasten the switches to the panel. Mount rectifier D1 in place on its mounting stud, and check all wiring carefully.

Pretesting. Turn R1 and R2 counter-clockwise as far as possible. Switch SW1 to off and SW2 to high range. Plug in the ac power cord, and with a vom set for a-c, check voltage across the transformer input. It should read 12.6 volts. Next close switch SW1 and measure d-c across capacitor C1.

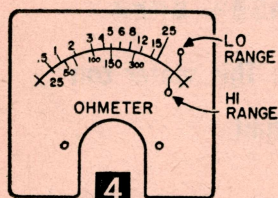




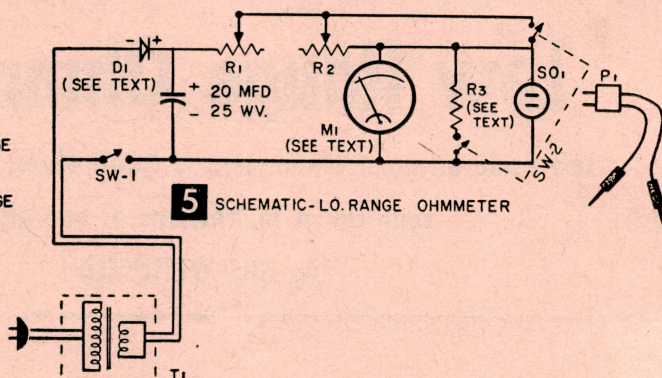
3 The filament transformer is housed in a small aluminum box (top). Mount the silicon rectifier on an L-shaped aluminum bracket. It is located between the meter and capacitor fastened to the panel with the top switch mounting holes.



4 A TRANSFORMER CASE



4 METER SCALE AFTER CALIBRATION



5 SCHEMATIC-LO. RANGE OHMMETER

This should be about 16 volts. Turn S1 off and plug test clips into SO-1.

With your vom on a 10 ma. range, clip the leads to the low range ohmmeter test clips. Turn switch SW1 to on and slowly turn R1 up until the vom reads half scale. Then turn R2 clockwise to bring the meter to full scale. If either test causes the meter to swing down

scale, reverse pot connections. With tests finished, complete assembly by installing the milliammeter.

Calibration requires you remove the plastic meter cover. Pry it up with a thin screw driver at several places until the cover snaps off. Use a small sharp screw driver to remove the meter scale plate and replace with a dial (Fig. 4) drawn on white card stock.

Let's assume that you want low scale to read 0-25 ohms. Place a zero mark about 1/4 in. left of the meter's full scale point. Clip a 3.9-ohm resistor across the test clips, set R1 to low and switch SW-1 on. Slowly turn R1 clockwise until the meter reads at the new zero mark. Turn SW-1 off, and clip a 25-ohm resistor in parallel with the 3.9-ohm resistor. Turn SW-1 on. The meter should rest about 1/4 in. to the right of zero left. If the needle rests too far to left, you will need a larger value, say 4.3 ohms. If it is too close to zero, try a smaller resistor such as 2.9 ohms. During trials *never remove the resistors from the test clips without turning SW-2 off.*

After soldering the shunt resistor into the instrument circuit, calibrate the other scale points using 4 or 5 intermediate resistors. When the shunt is in place, you no longer need to turn SW-2 off when changing resistors. Accuracy of the meter depends on the

MATERIALS LIST—LOW RANGE OHMMETER

No.	Size and Description
M1	0-1 ma Meter, Olson Radio #ME-68 Note: Meter scale is typical. Any 10, 25, 50, or 100 ma meter can be used, but scale plot will vary.
D1	2 amp silicon rectifier, Olson Radio #RE-66 or equal
T1	2.6v filament transformer, Olson Radio T-304
R1	5000 ohm 1/4-watt potentiometer, Lafayette VC-937
R2	25,000 ohm 1/4-watt potentiometer, Lafayette VC-941
R3	3.9 ohm 2 watt carbon resistor. Value depends on meter used, scale desired, etc. See text.
C1	electrolytic capacitor, 25 mfd, 25 W.V., Lafayette #C-129
SW-1	SPST slide switch, Lafayette #SW-14
SW-2	DPST slide switch, Lafayette #SW-16
SO-1	Cinch-Jones chassis mounting 2 conductor socket #S-2402-DB (Allied #22H481)
P1	Cinch-Jones 2 conductor plug, #P-402-CCT (Allied #40-H-910)
1	set of universal test leads, Lafayette #F-373
1	minibox, 2 3/4 x 2 1/8 x 1 5/8, Lafayette MC-358
1	plastic case, 6 1/4 x 3 3/4 x 2, Lafayette MS-216
1	panel for above, Lafayette MS-217
Misc.	6-32 th machine screws, line cord

Sources: Olson Electronics, Inc., 260 S. Forge St., Akron 2, Ohio
Allied Radio, 100 N. Western Ave., Chicago 80, Ill.
Lafayette Radio, 111 Jericho Turnpike, Syosset, L. I., New York

calibration resistors: for example, if you use 1% resistors you'll get accuracy around 2%.

Calibrating the High Range. Whenever you switch from range to range, be sure to turn the unit off to protect the meter. On high, turn R2 clockwise until the meter reads at the zero mark established earlier. Again use about 5 different values of resistors to mark points on the scale. Ink in your numbers, and replace the plastic cover.

Any low ohmage range can be calibrated. For example, if you want a $\frac{1}{40}$ - to 2-ohm scale select a trial resistor, say 2 ohms, and test as before. Then add another 2-ohm resistor and note the meter deflection. The object is to select a shunt that allows the meter to indicate top value at the desired point on the scale. You'll find the meter may require occasional zero adjustment to compensate for varying line voltage.

Compass Galvanometer

MANY electrical measuring instruments are based on the design of the d'Arsonval String Galvanometer, but substitute a needle-suspended coil riding on jeweled bearings for the hanging coil employed in the original precise lab instrument.

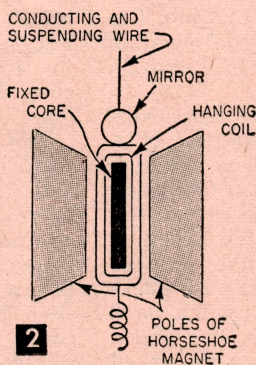
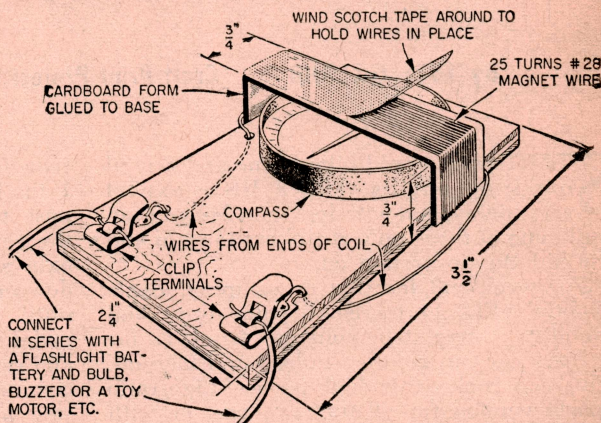
The galvanometer is not often used to measure quantity of current flowing in a circuit, but usually to indicate the polarity and presence of small currents by comparison methods.

The d'Arsonval instrument suspends a small coil between the poles of a permanent horseshoe magnet. When a current flows through the coil it becomes an electromagnet and its like poles repel the like poles of the horseshoe magnet, thus causing the coil to turn or twist on the metallic string or ribbon by which it is suspended (Fig. 2). The strength of the current determines the extent of the coil's rotation.

A small pointer attached to the moving coil registers on a curved dial, or a tiny mirror is attached to the galvanometer string. A beam of concentrated light is aimed at the mirror, bouncing the beam off to a wall screen or chart to give great magnification of tiny current changes.

Making a Simple Galvanometer. A small amount of insulated magnet wire, any pocket compass and a $2\frac{1}{4} \times 3\frac{1}{2}$ -in. scrap of plywood is what you need to make the simple galvanometer shown in Fig. 1. Cut a strip of cardboard $\frac{3}{4}$ in. wide and $3\frac{3}{4}$ in. long. Score the cardboard $\frac{3}{4}$ in. from each end, with a dull knife blade and crease so the cardboard resembles a C or bridge shape. Now glue the cardboard to the edges of the wood base.

Bind the cardboard with a rubber band until glue or cement dries. We wound 25 turns of #28 magnet wire around the cardboard, but heavier



wire and fewer turns will work, too, with a slight drop-off in sensitivity.

Scotch tape is wound around the finished coil to keep the wire turns in place. Connect the ends of the coil to screw terminals or clips. Slip the compass under the coil in a position where its needle comes under the coil and parallel to the coil turns.

Connect the galvanometer in series with a flashlight battery and bulb, a buzzer or a toy motor, etc. When the circuit is

closed the compass needle will be drawn so that it is at right angles to the coil (Fig. 1). A slow swing of the needle indicates the circuit is drawing little current. A rapid swing denotes an increase in current flow.

To show how sensitive this simple galvanometer is, connect what appears to be a dead flashlight cell across the terminals, immediately breaking the circuit. The compass needle will spin at a merry clip indicating there is still some life in the "dead" cell.

The compass galvanometer's needle would be the horseshoe magnet in the d'Arsonval instrument. But, here we cause the magnet to turn with the coil remaining in a stationary position. However, the end result is the same no matter how the galvanometer is constructed.—T. A. BLANCHARD.

TOTE-ALL SCOOTER

You can lug all your gear and cover ground fast and easy, whether you're playing golf, hunting, or just plain roamin'

By **LYLE GILLIOM**

Craft Print Project No. 326

START with an old bike frame and a used one-lung engine, add a little expert scrounging, and with less than \$40 you can build one of these mile-shrinkers for you and the kids to zip around on.

For week-end hunting or camping, *Beats Walkin'* (Fig. 1) increases your range and mobility. Carry it in your car trunk as far as your car can go, then unload and take off. You can make this high-power, high-ratio sports version for off-the-road use, or with high power and low ratio, but without the load-rack, and you have a fast street job. The same machine with *low* power and *high* ratio is ideal for the younger tots to learn on (Fig. 11).

If you're in a real hurry to save shoe leather, the quickest answer is the Buzzbike (Fig. 2), with a one-stage reduction drive for high speed (26-28 *mph*), and bike-pedal foot rests.

Beats Walkin' for street operation has pneumatic tired wheels and a top speed of about 26 *mph* with a 2½ or 3 *hp* 4 cycle engine. The child's model is primarily for backyard operation by children as young as 6 years old. With semi-pneumatic tires and a 10.5 to 1 drive ratio it will have a top speed of 10 or 12 *mph* using a 1½ to 2 *hp* engine.

Controls for all versions consists of a hand throttle on the handle bars, a brake operated with the heel of the right foot, and automatic clutching with a centrifugal clutch.

Any 26 in. balloon tire type frame can be used. The girls' model (Fig. 11) is preferable for use by smaller children since the absence of the top bar makes it easier to get off and on. Junked bicycle frames are not hard to find and they are usable for our purposes in almost any condition. Many shops will sell a used frame torn down and stripped of paint very cheaply. Or you can buy a "junker" and tear it down yourself, discarding unneeded or unusable parts.

Modification of the bicycle frame to accommodate the engine is shown in Figs. 3 and 5. Saw out and discard a section of the upper

rear fork from about 1 in. behind the seat post to 6¼-in. above the center of the rear axle slot. Then bend down the lower fork until the front fork, pedal crank housing and rear fork rest on a common base. Hack-saw almost through the fork just behind the crank housing, if necessary, and bend the fork down. Then close the gap by welding.

The simple wooden welding jig (Figs. 3 and 5) positions and holds together all the components of the frame so that it can be taken to a welding shop for welding, already fitted and assembled. A local welding shop took approximately 35 minutes to do ours including the welding of the brake shoe assembly; total charge was \$3.50.

Make the Welding Jig from construction grade fir assembled with 2¼-in. #10 flathead wood screws. Bolt the bicycle frame to the jig with the front and rear axle bolts, spreading the forks as necessary to fit the blocks of the jig. For cleaner welds, clean all paint from the frame in the areas to be welded.

Check all dimensions with your frame mounted on the jig before making the parts which are to be welded to the frame, as there is considerable variation of styling in frames. Make the brake shoe components too (Fig. 10), so that this assembly can be welded on the same trip.

Secure the Pipe U-Frame in position with C-clamps (Fig. 3). Filing a concave notch



Young man-in-a-hurry gets around on campus the easy way on the Buzzbike.

Why walk a country mile when Beats Walkin' will tote you and all your gear? Convert it to camping use by packing a bed-roll instead of the golf bag.



in the sawed ends of the bicycle frame to match the round contour of the pipe will aid in keeping the U-frame in position.

Fit and position the two jackshaft bearing supports (Fig. 23) and bolt them to the plywood location block. Determine exact dimensions of these parts by fitting to the frame. Tack-weld all joints, including threaded pipe joints, then remove the frame from the jig for final welding.

A $\frac{3}{8}$ x 3 in. long pipe nipple drilled out with a $\frac{1}{2}$ in. drill serves as a bearing for the brake pedal pivot bolt. Install it in the pedal crank housing with two spacers— $\frac{5}{8}$ -in. wrought washers—held with two pipe lock-nuts (Fig. 9). These spacers bear against the inner races of the pedal crank bearings, the rest of which are discarded.

Wooden Parts. Saw out the engine deck,

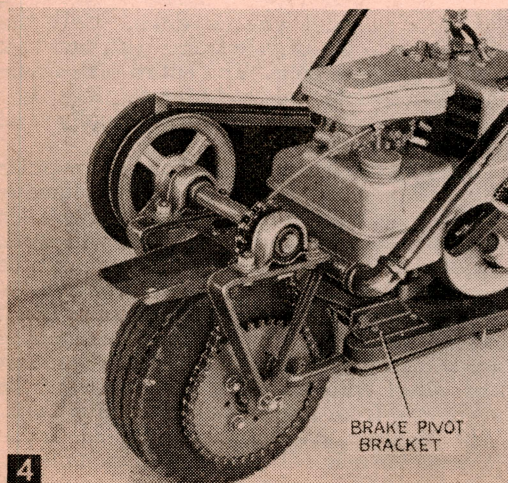
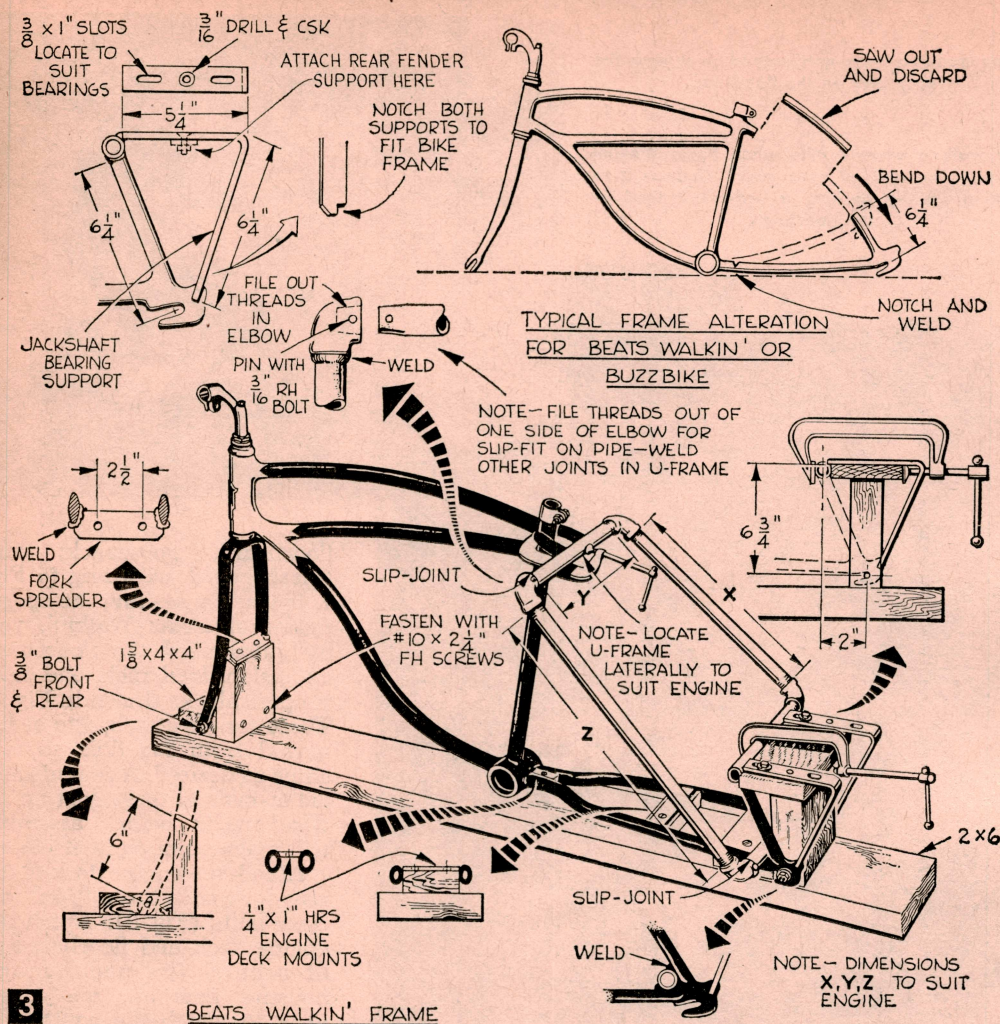
floorboard, gooseneck, and splash guard according to Fig. 7. If you are making the sports model of Beats Walkin', you will also need the floorboard extension, load rack, and rack support blocks shown in Fig. 7. These can be attached to or removed from the finished machine as desired. A coat of shellac or enamel undercoat on all wood parts before assembly will make painting later easier.

Attach the engine deck to the rear fork with three $\frac{1}{4}$ -in. carriage bolts (Fig. 8). Notch the engine deck and floorboard to fit around the pedal crank housing. Saw out the gooseneck to match the contour of the bicycle frame (Fig. 7). Now assemble the floorboard with the splash guard, gooseneck, and engine deck. Bolt the

gooseneck to the bicycle frame with two $\frac{1}{4}$ x $5\frac{1}{2}$ in. carriage bolts. The entire bike frame is now complete and ready for painting. Use implement paint, which works equally well on wood or metal.

Wheels for Beats Walkin' are the popular 4.10-3.50 x 4 in. (10.6 in. O.D.) pneumatic kart wheels with $\frac{3}{4}$ in. bore ball bearings. Or use 3.4/3.00 x 5 in. wheels, which will work equally well. If the bike is to be geared for high speeds, wheels with tapered roller bearing hubs should be used (See Materials List).

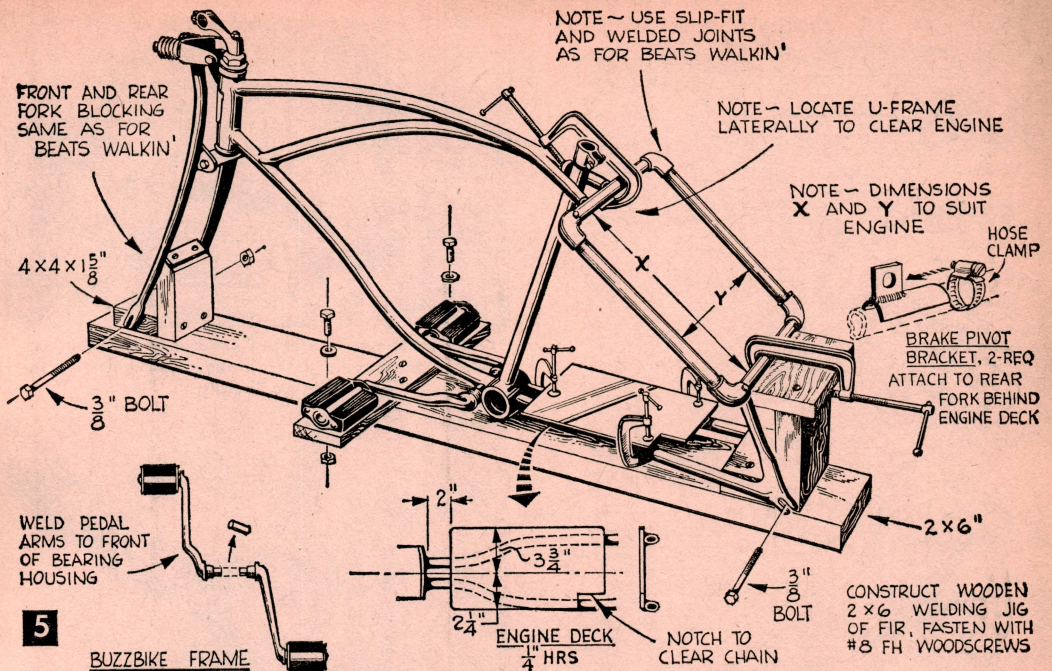
Sprocket, spacer ring, and wheel assemblies are shown in Fig. 12. The 40-tooth sprocket and wheel with matching bolt holes can be purchased from Sears (made by Indus Corp., 1815 Madison Ave., Indianapolis 25, Ind.). Replace the original bolts which assemble the wheel with $\frac{3}{8}$ in. x $3\frac{3}{8}$ in. long studs cut from



3/8 in. threaded rod (Fig. 12), and three nuts for each rod. The spacer rings are cut from 3/4 in. fir plywood and 1/8 in. hardboard to fit snugly inside the rim of the wheel. Total thickness should be 7/8 in., or enough to ensure that the chain will clear the tire. Paint the rings prior to installation. Standard rear wheels for go-carts made with extended hubs and flange for attachment of sprockets cannot be used as the width is too great for the bicycle rear fork. (See Materials List for a source of special parts.)

Wheels for the Child's Version are the much less expensive semi-pneumatic 2.75 x 10 in. O.D. with either 3/4-in. or 5/8-in. ball bear-

The sports version of Beats Walkin' has a two-stage speed reduction ratio of 14.5:1, giving a top speed of about 8 mph with a 2 1/2- to 3-hp engine.



ings. Sprocket, wheel, and spacer rings are shown in Fig. 12B. (The use of 1 in. pitch sprockets and chains is not suggested because matching engine sprockets are not generally available.)

Vehicle Speed is easily calculated with the following formula:

$$\text{Speed (mph)} = \frac{\text{Engine rpm} \times \text{Wheel circumference in feet}}{88 \times \text{Overall drive ratio}}$$

For example, to find the speed with the engine turning at 3600 rpm, a wheel circumference of 2 1/2 feet, and a drive ratio of 4 to 1:

$$\text{Speed (mph)} = \frac{3600 \times 2.5}{88 \times 4} = \frac{9000}{352} = 25.6 \text{ (approx.)}$$

Also, you can determine desired drive ratios, starting with a known speed, with the same formula rearranged:

$$\text{Drive Ratio} = \frac{\text{Engine rpm} \times \text{Wheel circumference in feet}}{88 \times \text{Speed (mph)}}$$

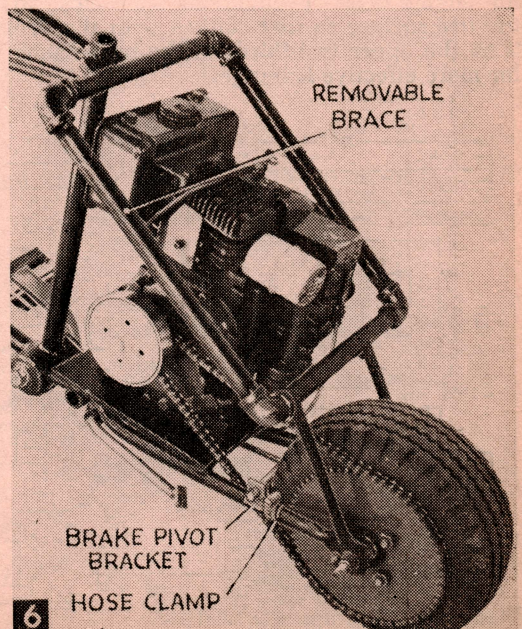
For example (using the same values as before):

$$\text{Drive ratio} = \frac{3600 \times 2.5}{88 \times 25.6} = \frac{9000}{2252.8} = 4 \text{ (Approx.)}$$

Axles and Jackshaft (Fig. 10) are the only machined items required. Milled keyways in the jackshaft are strongly recommended. Jackshaft bearings of the self-aligning type can be sealed ball bearings or bronze bearings. Use #35 or #41 roller chain and matching sprockets on bikes intended for

adult use. For a child's bike, 1/2 in. bicycle chain and sprockets are suitable. An offset or half-link may be used along with a regular connecting link to get the needed chain length.

The Brake consists of a drag-shoe applied



Drive of this Buzzbike is a one-stage 6:1 reduction, gives speeds up to 18 mph. For this outfit, a simpler frame alteration is employed.

MATERIALS LIST A—BEATS WALKIN'

No. Req'd	Size and Description	Use	No. Req'd	Size and Description	Use
1	$\frac{3}{4}$ x 18 x 30" fir plywood	floorboard, engine deck, wheel spacer ring	1	$\frac{1}{2}$ 1 D. x $\frac{3}{4}$ " long x 13 gauge compression spring	brake return spring
1	$\frac{1}{4}$ x 24 x 24 $\frac{1}{2}$ " hard-board	splash guard, belt guard	*1	$\frac{3}{8}$ x 30" threaded steel rod	front and rear axles, drive wheel assembly
1	$\frac{3}{4}$ x 6 x 12" hardwood or fir	gooseneck	4	$\frac{3}{4}$ " bore steel shaft collars	front and rear axles
1	$\frac{1}{4}$ x 1 x 43" hot rolled steel	brake pedal, jackshaft bearing supports, front fork spreader, engine deck plates	*1	$\frac{5}{16}$ brake rod clevis	brake rod
1	$\frac{1}{8}$ x $\frac{3}{4}$ x 15" hot rolled steel	splash guard straps, rear fender support	*2	$\frac{3}{4}$ " bore self-aligning ball bearings (Dodge Mfg. Corp., Mishawaka, Ind. or $\frac{3}{4}$ " bore self-aligning bronze bearings — Congress Drives Div., 3750 E. Outer Dr., Detroit 34, Mich.)	jackshaft bearings
*1	$\frac{1}{4}$ x 2 $\frac{1}{2}$ x 3 $\frac{1}{2}$ " hot rolled steel	brake shoe	*2	$\frac{3}{4}$ " bore steel shaft collars	for bronze jackshaft bearings only
*1	$\frac{1}{2}$ " dia. x 6 $\frac{1}{2}$ " cold rolled steel	brake shoe	*1	throttle control with 6 ft. cable	engine
*1	$\frac{5}{8}$ " dia. x 1 $\frac{1}{2}$ " cold rolled steel	brake shoe	Parts for Adult Version of Beats Walkin' Only		
*1	$\frac{3}{4}$ " dia. x 18" cold rolled steel	jackshaft, front and rear axle	4	4.10/3.50 x 4" pneumatic tires and wheels; $\frac{3}{4}$ " bore Killian ball bearings Zerk fitting for grease (Indus. Corp., 1815 Madison Ave., Indianapolis 25, Ind.)	
*1	$\frac{5}{16}$ " dia. x 14" cold rolled steel	brake rod	1	5" B-section V-pulley, $\frac{3}{4}$ " bore	
1	$\frac{1}{8}$ x $\frac{1}{8}$ x $\frac{1}{8}$ x 21" aluminum or steel angle	floorboard splice angles, brakeshoe bearings, spring compression bracket	1	B-section V-belt (length determined on assembly)	
1	$\frac{1}{2}$ " black iron pipe, approx. 52" long	U-frame and removable frame brace	*1	14 tooth sprocket for #41 chain, $\frac{3}{4}$ " bore (Diamond Chain Co., Inc., 402 Kentucky Ave., Indianapolis 25, Ind.)	
*1	.040" aluminum sheet, 12 x 16"	fenders (optional)	*1	40 tooth steel plate-type sprocket, 21" center hole (Indus. Corp.)	
1	$\frac{1}{16}$ x 1 x 1" aluminum angle, 24" long (Reynolds Do-It-Yourself)	belt guard	*2 $\frac{1}{2}$ ft.	#41 Industrial roller chain, with connecting links (Diamond Chain Co.)	
1	26" balloon tire bicycle frame with handle bars and saddle		Parts for Child's Version of Beats Walkin' Only		
1	$\frac{3}{8}$ " pipe x 3" black iron nipple	brake pedal bearing	2	10 x 2.75 semi-pneumatic wheels, $\frac{3}{4}$ " ball bearings —2 req.	
*4	$\frac{1}{2}$ " black iron pipe 90° elbows	U-frame & removable frame brace	1	6" A-section V-pulley, $\frac{3}{4}$ " bore	
*1	Automatic clutch with 3" V-pulley to fit engine shaft (Mercury Clutch Div., 1201 Camden Ave., S.W. Canton 6, Ohio)	U-frame & removable frame brace	1	A-section V-belt (determine length on assembly)	
			1	13 tooth sprocket for #65 chain, $\frac{3}{4}$ " bore (Diamond Chain Co., Inc.), for use with $\frac{1}{2}$ " pitch bicycle chain and 48 tooth bicycle pedal sprocket (or use 12 tooth sprocket with 44 tooth pedal sprocket)	
			1	$\frac{1}{2}$ to 2 hp horizontal shaft, 4 cycle gasoline engine	

Items marked * and all items in Materials List B can be obtained from Gilliom Power Tools, 1109 N. Second St., St. Charles, Missouri.

MATERIALS LIST B—BEATS WALKIN'

Part No.	Size and Description	Part No.	Size and Description
321-T	Front Wheel (high speed) 4.10/3.50 x 4" pneumatic tire, tube, and wheel, $\frac{3}{4}$ " bore Timken tapered roller bearing in 3" long demountable hub. \$12.50	335-12	Sprocket for Jackshaft, 12 tooth for #35 chain, 1.63" O.D., $\frac{3}{4}$ " bore, \$2.40
321-TF	Rear Wheel (high speed). Same with extended hub and 4-bolt flange for sprocket mounting. \$13.95	345-B	5" dia. V-Pulley for "B" section belts, $\frac{3}{4}$ " bore with keyway and setscrew. Die cast. \$1.50
321	Wheels (low speed). Same as 321-T except Killian $\frac{3}{4}$ " ball bearings, Zerk fitting. \$9.95	346-A	6" dia. V-Pulley for "A" section belts, $\frac{3}{4}$ " bore. Die cast. \$1.10
323	Axles for #321 $\frac{3}{4}$ " ball bearing wheel, $\frac{3}{8}$ " dia. treaded ends, two-shaft collars. Set of two for 4 and 5 $\frac{3}{8}$ " fork widths. \$2	348-A	8" dia. V-Pulley for "A" section belts, $\frac{3}{4}$ " bore. Die cast. \$1.70
323-T	Axles for $\frac{3}{4}$ " Timken bearing wheels #321-T and 321-TF. $\frac{3}{8}$ " dia. treaded ends, $\frac{3}{4}$ " safety take-up nuts. Set of two for 4" and 5 $\frac{3}{8}$ " fork widths. \$3	351	Brake pedal. Cast aluminum pedal, $\frac{1}{2}$ " x 4" spindle bolt, two $\frac{1}{2}$ " jam nuts. \$1.40
331	Sprocket Type Clutch for #35 chain. Adjustable for 2 or 4 cycle engines. 10, 11, 12, or 13-tooth. State number of teeth desired and engine shaft size. \$10.90	352	Brake rod assembly. $\frac{5}{16}$ " dia. x 12" long rod, adjustable steel yoke, special clevis bolt, pedal return spring. \$1.40
330	V-Belt Type Clutch. Same features as 331 except 3 dia. pulley for V-belt drive. For 4 cycle engines only. \$7.50	353	Brake shoe assembly. Special contoured cast aluminum drag, steel lever and shaft. Automatically self-aligning with tread of tire for maximum braking effect. \$2.20
337	Throttle Control Cable. 60" long. \$1.60	354	Pivot bearing for brake shoe assembly. Clamp to arms of rear fork with gear-type hose clamps as shown on Buzz-Bike. Set of 1 left and 1 right, 2 hose clamps. \$1
335-60	Sprocket, 60 tooth for #35 chain. Steel plate type. 7.38" O.D., 2" center hole, four bolt holes. Fits 321-TF wheels, or #321 and 321-T wheels, with spacer. \$2.90	355	Complete brake kit. All of above parts plus 3" treaded nipple, lock nuts, and spacer washers for installing pedal in bicycle crank housing. $\frac{1}{4}$ " eye-bolt for pedal return spring. \$5.90
335-C	#35 Roller Chain, $\frac{3}{8}$ " pitch, 3 ft. long with master connector link. \$3.90	310	Bandless 90° elbows without threads for slip fit on $\frac{1}{2}$ " iron pipe U-frame. Eliminates pipe threading. $\frac{1}{2}$ " #10 self-tapping screws included. Set of four. \$1.40
335-H	Offset Connector Link for $\frac{3}{8}$ " chain. 45¢	311	Engine Deck (Buzz-Bike only) $\frac{5}{16}$ x 6 x 9" steel and $\frac{3}{16}$ x 1 x 4" steel for front fork spreader. \$1.20
335-M	Master Connector Link. Same as furnished with chain. 25¢	312	Fenders. 18 gauge rolled steel; bolt or weld to bike frame. Not painted. Each \$2. Set of two \$3.70
341-40	Sprocket, 40 tooth for #41 chain. Steel plate type. 6.65" O.D., 2" center hole, four bolt holes. For #321-TF or 321-T wheels. \$2.90	313	Front Fork Replacement for most 26" balloon-tire type bicycles. Heavy duty solid forged steel, stronger than tubular type. Prime coated. \$2.50
341-34	Sprocket, same as above except 34 tooth for #41 chain. 5.7" O.D. \$2.50	BB-11	Kit for Buzz-Bike. With #321-T and 321-TF wheels, #323-T axles, #331 clutch (state choice of 10, 11, 12, or 13-tooth sprocket and $\frac{5}{8}$ " or $\frac{3}{4}$ " bore), #335-60 wheel sprocket, #335-C roller chain, #337 throttle control cable, #351, 352, and 353 brake components, #310 elbows and #312 engine deck. ($\frac{5}{8}$ " iron pipe U-frame and fenders not included.) \$49.50
341-C	#41 Roller Chain, $\frac{1}{2}$ " pitch, 2 $\frac{1}{2}$ ft. long master connector link. \$2.25	BB-31	Buzz-Bike Kit with 3 hp 4-cycle Briggs and Stratton go-cart type engine. Mechanical governor, direct carburetor control, half-gallon gas tank, recoil starter, aluminum cone, red enamel finish. (Kit has 13-tooth sprocket clutch for 4.6 to 1 drive ratio.) \$88.90
341-H	Offset Connector Link, for $\frac{1}{2}$ " chain. 45¢		
341-M	Master Connector Link. Same as furnished with chain. 25¢		
340	Ball Bearing Pillow Blocks. $\frac{3}{4}$ " bore greased for life, self-aligning, steel housing. Set of two. \$4.70		
342	Bronze Bearing Pillow Blocks. Similar to above except $\frac{3}{4}$ " bore bronze sleeve bearing. Has oil cups, steel thrust collars. Set of two. \$2.40		
343	Jackshaft $\frac{3}{4}$ " dia. x 8 $\frac{1}{2}$ " long steel, $\frac{3}{16}$ " milled keyway for V-pulley and sprocket. \$1.50		
341-12	Sprocket for Jackshaft, 12 tooth for #41 chain. 2.17" O.D. $\frac{3}{4}$ " bore with keyway and setscrew. \$2.25		
341-14	Sprocket for Jackshaft same as above except 14 tooth for #41 chain, 2.49" O.D. \$2.50		

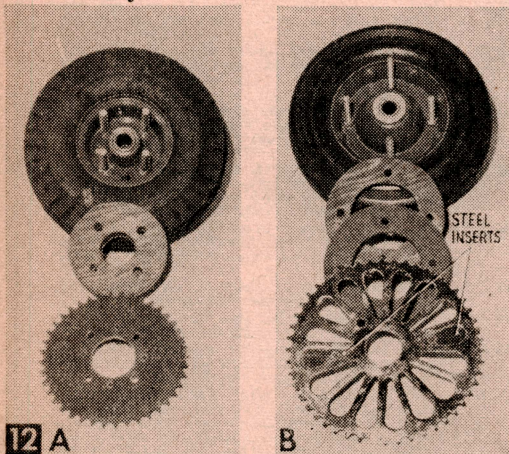


Two of the author's children here demonstrate the low-power, low-speed version of Beats Walkin'. Girls' model at left is best for the smaller tykes.

and the drive ratio altered as desired by changing the jackshaft V-pulley, the chain drive sprockets, or both. The Beats Walkin' (street model) or Buzzbike ratio is approx. 4.3 to 1, which should give a top speed of approx. 26 mph at 3600 engine rpm. With a 2½ or 3 hp motor this ratio provides for rapid acceleration and good hill climbing ability.

Use the formula previously given to determine pulley sizes for the two-stage drive. For instance, a 3-in. engine pulley and an 8-in. jackshaft pulley give a ratio approximately 2.6 to 1. Multiply this by the sprocket ratio (say 4 to 1) to get the overall ratio: in this case 10.4 to 1.

Engine Drive is by means of an automatic centrifugal type clutch which attaches directly on the engine shaft and takes either A or B belts. Because of variations in engines and frames, belt length must be determined on assembly.



Left, a wheel, spacer, and 40-tooth sprocket for a high speed model. Tire is 4.10-3.50x4 pneumatic. Threaded rods replace original bolts. Right, similar parts for child's model, with 10x2.75 semi-pneumatic tire, 48-tooth bicycle sprocket, and spacers. Note steel inserts in spokes to position rods.

Install a throttle lever of the lawn mower type on the handle bar with a 6-ft. cable connected to the governor or carburetor. Some newer engines now provide for direct carburetor control between idling and full throttle positions. Such control would be ideal for these bikes.

Belt Guard. A hardboard or plywood belt guard is shown in Fig. 7. Because of variations in engines and frames, dimensions must be checked and the pattern altered as neces-



You don't have to be in the chips to build a Buzzbike. This one has 6 to 1 reduction for 18 mph top speed.

sary. The aluminum angle has part of one flange removed to clear the clutch. Bolt the removable U-frame brace to the guard with two ¼ x 1½ in. rh stove bolts, so that for engine service the brace and guard can be removed as one unit.

Make fenders (Fig. 10) of half-hard aluminum sheet (0.040 in. thick), which is easily hand-formed, or 22 to 26 gauge sheet steel.

All That is Left is to gas up and go. Beats Walkin' should have a range of 15 to 20 miles on a quart of fuel. Some of the newer engines have 2-quart fuel tanks that would double this range. Many standard bicycle accessories such as luggage carriers, baskets, lights, and horns can be added. Street operation will require both a license plate and a licensed operator, so check with your local license bureau or police department for regulations in your area.

● Craft Print No. 326 in enlarged size for building Tote-All is available at \$2. Order by print number. To avoid possible loss of coin or currency in the mail, we suggest you remit by check or money order (no CODs or stamps) to Craft Print Div., SCIENCE and MECHANICS, 505 Park Ave., New York 22, N. Y. Please allow three to four weeks for delivery. Special quantity discount! If you order two or more craft prints (this or any other print), you may deduct 25¢ from the regular price of each print.



A metronome teaches the music student a sense of timing and pace from the very start. Volume is ample for small group practice or can be cut down so you just barely hear the clicks.

TIMER Sets the BEAT

You don't have to watch a clock or push buttons with this \$16 electronic metronome-timer

By JOSEPH R. NOONAN



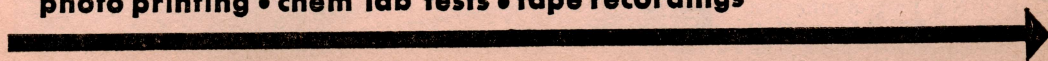
With the metronome clicking the exact beats per second, the advanced musician knows he's playing at the tempo indicated on the music sheet by the composer.

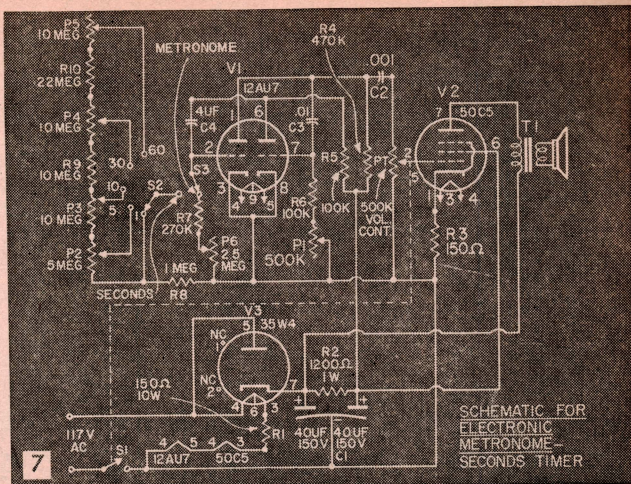
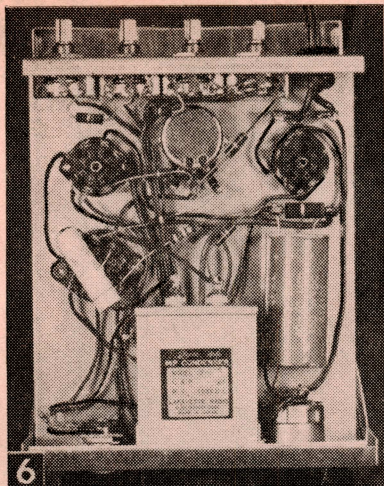
Use it to pace....

music practice • rhythm calisthenics • dance practice
gymnastics • high-speed typing

and to time....

photo printing • chem lab tests • tape recordings





Calibration is Next, after a wiring check. Turn S3 to "seconds" and S2 to the one-second position. Turn the unit on with volume about half way up. You should hear ticks from the speaker in about 30 seconds. Allow a ten minute warm up period, and then use an electric clock second hand to adjust pot P1 until the click frequency is exactly one per second. Pot P1 is left in this position throughout the rest of the calibration.

Next turn S2 to the 5 second range and adjust P2 for a 5 second click interval. Repeat with P3 for 10 seconds, P4 for 30 seconds and P5 for 60 seconds. Probably the timer won't split seconds on the 60 second range. A 5% accuracy on the one second range means an error of plus or minus only $\frac{1}{20}$ of a second, while on the one minute range would account for an error of plus or minus 3 seconds per minute.

Calibrating the Metronome. With P1 as previously adjusted so the speaker clicks exactly every second on the one second range, turn S3 to *Metronome* position. Adjust P6 until the timer ticks eighty per minute when the pointer points straight up. Then calibrate the dial on either side of center to cover a range of 40 to 208 clicks per minute. Pot P6 will cover down to 25 per minute and can be so calibrated if desired. If no use of this extended range will ever be made, a 1.5 megohm can be used instead of

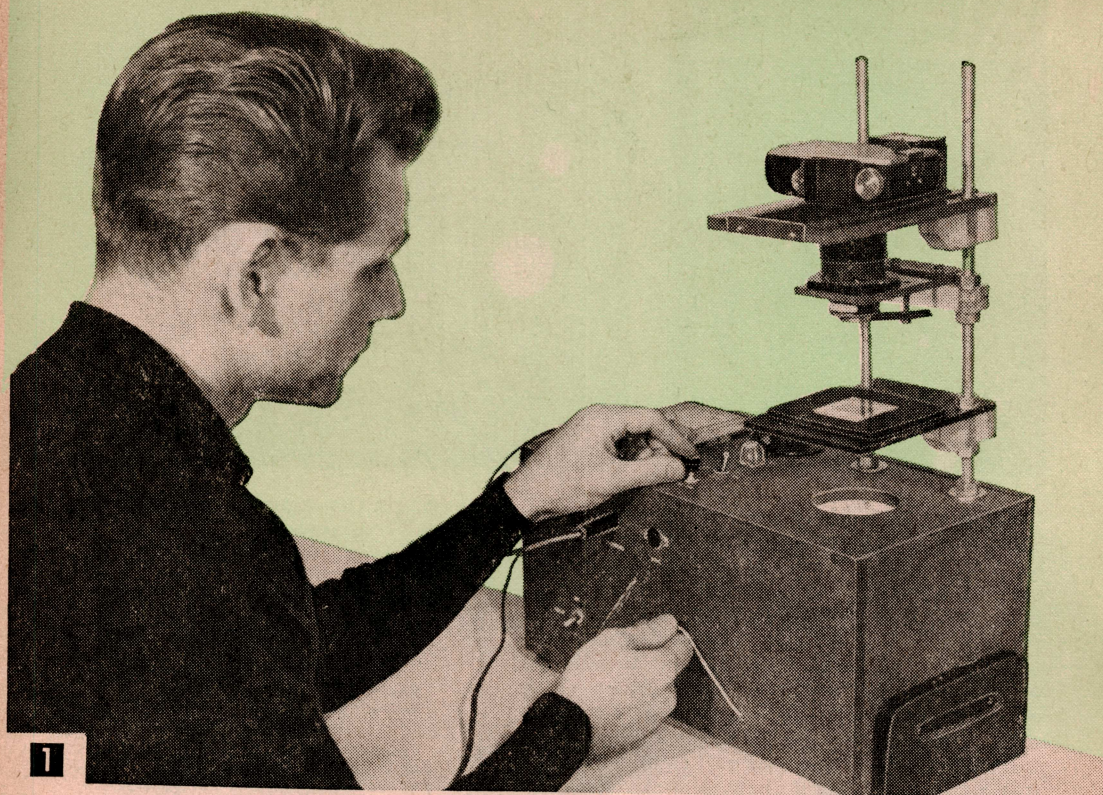
MATERIALS LIST—ELECTRONIC PULSE GENERATOR

No. Req.	Size and Description
RESISTORS	
1	R1—150 ohm, 10-watt wire wound
1	R2—1200 ohm, 1 watt
1	R3—150 ohm, $\frac{1}{2}$ watt
1	R4—470K, $\frac{1}{2}$ watt
2	R5, R6—100K, $\frac{1}{2}$ watt
1	R7—270K, $\frac{1}{2}$ watt
1	R8—1 meg, $\frac{1}{2}$ watt
1	R9—10 meg, $\frac{1}{2}$ watt
1	R10—22 meg, $\frac{1}{2}$ watt
POTENTIOMETERS	
1	P1—500K ohm IRC Q11—133
1	P2—5 megohm IRC Q11—141
3	P3, P4, P5—10 megohm IRC Q11—143
1	P6—2.5 megohm IRC Q11—239 (or 1.5 megohm IRC Q11—138—See Text)
1	P7—500K ohm volume control with switch S1
CAPACITORS	
1	C1—40-40 mfd. 150 v. electrolytic (Lafayette C-126)
1	C2—.001 mfd. 600 v. molded by-pass (Lafayette C-500)
1	C3—.01 mfd. 600 v. molded by-pass (Lafayette C-503)
1	C4—4 mfd. 150 v. oil filled paper (Lafayette CF-115)
CHASSIS ITEMS	
2	7 pin miniature tube socket (Cinch-Jones type 7W2A)
1	9 pin miniature tube socket (Cinch-Jones type 9W1)
1	V1—12AU7 tube
1	V2—50C5 tube
1	V3—35W4 tube
1	T1—output transformer 2500 ohm to 3.2 ohm speaker (Lafayette TR-10)
1	S2—5 position rotary switch (Lafayette SW-78)
1	S3—2 position rotary switch (non-shorting type)
1	4" PM speaker 3.2 ohm (Allied 81P616)
1	line cord and plug
1	5 $\frac{1}{4}$ x 4 $\frac{1}{2}$ x 1 $\frac{1}{2}$ " chassis (Lafayette MC-174)
Misc.	pointer knobs, mounting strips, hook-up wire, etc.

the 2.5 megohm value to eliminate the low end and provide a wider spacing of the calibration marks.

TROUBLE SHOOTING GUIDE

Symptom	Remedy
No click at any setting	Check rectifier, C1. If R2 overheats, look for short in C1. Check for shorted or open capacitors, C3 and C4.
Clicks but P1 will not calibrate at 1 second	Too low a timing interval indicates R6 or R8 too high in resistance value, or that C3 or C4 are too large or are leaky. Too high an interval indicates C3 or C4 or R6 or R8 too small in value.
Clicks but does not maintain calibration	Leaky capacitors C3 or C4. Change in resistance values from overheating may be due to restricted chassis ventilation or misplacement of parts.
Clicks but at erratic interval	Defective V1 tube. Poor contacts in S2 or S3. Defective P1. Occasional fluctuations may be caused by power line variations.



Build This

To duplicate a slide, you frame and focus the slide with the 100-watt focusing light. Then, flip the lever to the right and a reflector drops in place. Open the shutter, and push the strobe button to make the exposure.

35 MM Slide Reproducer

Duplicates color slides, makes reductions, enlargements from 16-mm movie film, corrects color balance, produces novelty color effects, and can be used for small-object photography

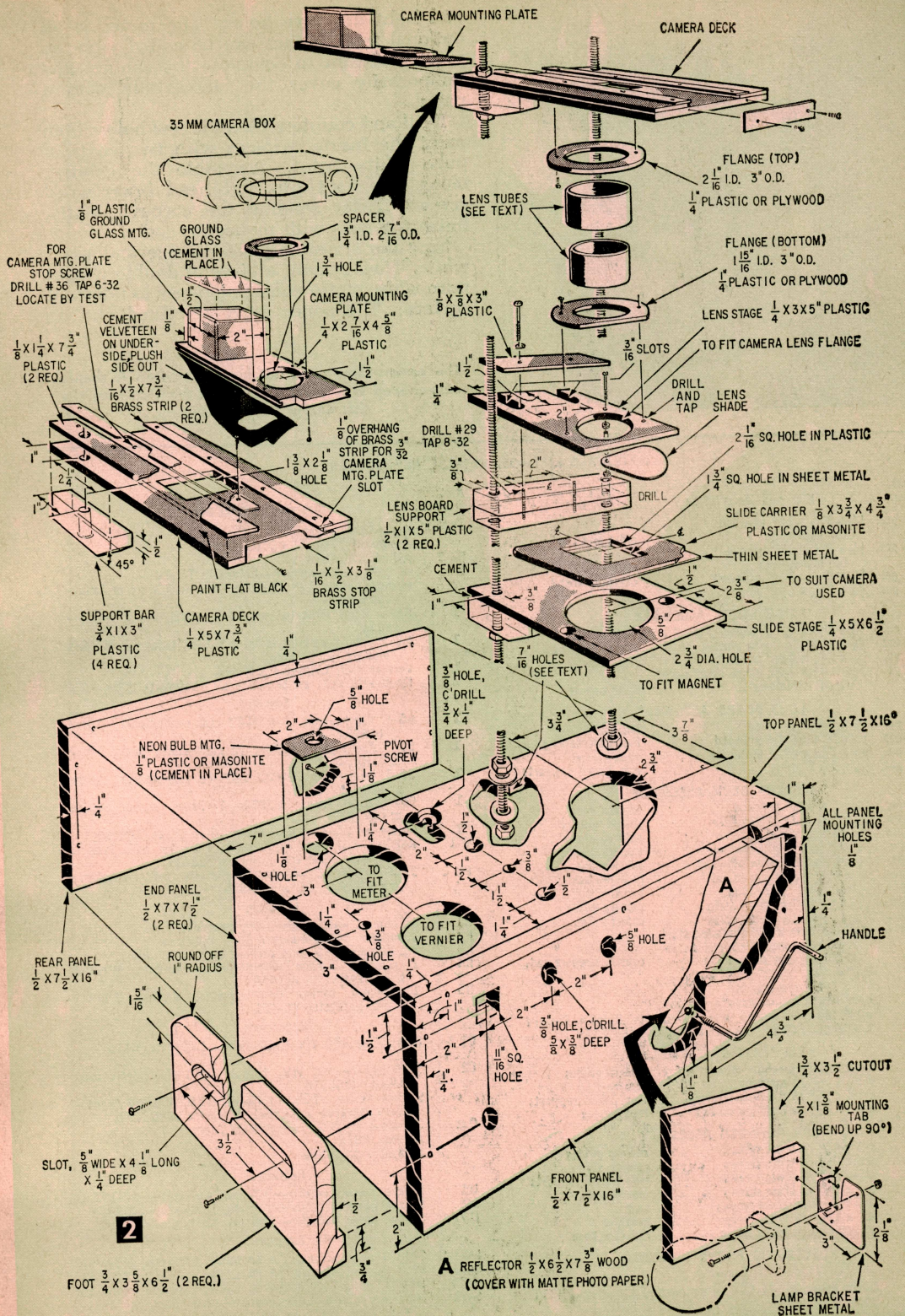
By GUS WESENFELD

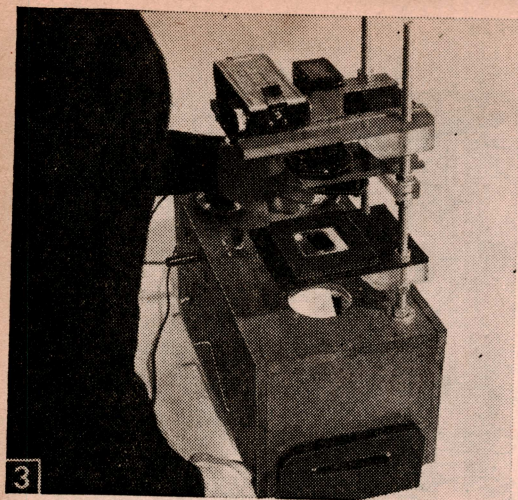
HERE are three designs for building slide reproducing equipment. You can complete the simple basic unit using only common hand tools for as little as \$15, including the price of a used camera. Then you can go on to add the exposure level meter for more accurate shooting and the electronic flashlight source for advanced photography.

A basic unit (Fig. 1) consists of a vertically-adjustable camera platform for varying copying size, a floodlamp light source, and a handy magnetic holder for the slide subject to be copied. If you own a 35-mm reflex camera equipped with lens extension tubes, all

you need on the camera platform is a mounting block for the tripod screw. Otherwise, you will need to add the camera lens board supports and deck (Fig. 2).

Saw the Pieces for the cabinet first. The Materials List calls for ½-in. mahogany, but if it isn't available in your area, you can substitute ½-in.-thick plywood. The holes for the outlet plugs and switches are easy to drill with spade type wood bits. Wherever a counterbored hole is shown, use the larger bit first until you reach the necessary depth. Then drill through with the required size hole bit. Use a hole saw or fly cutter to cut the meter





and light aperture holes. The meter is an optional feature that can be added later, so you may want to complete the cabinet and temporarily cover the meter hole with a panel.

Drill and countersink all screw holes; then paint the inside surfaces with two coats of pure white paint. Assemble the cabinet, using size 6 x 1 1/4-in. flat head brass wood screws. After sanding the corners lightly, finish the case with mahogany stain.

Saw the reflector panel to size and paint white. Now cement a piece of double weight pure white matte enlarging paper to the front surface. The paper must be "fixed out" in

The camera lens need not have a shutter. A simple cam-shaped lens cover keeps light from striking the film except during exposure.

MATERIALS LIST—35MM SLIDE REPRODUCER

Amt. Req.	Size and Description	Use	Amt. Req.	Size and Description
2 pcs.	1/2 x 7 1/2 x 16" plywood (or mahogany)	sides and top	1	4 pin tube socket
2 pcs.	1/2 x 7 x 7 1/2" plywood (or mahogany)	ends	50-5	Amphenol 77M1P4 OD DC Board Allied #40H024
1 pc.	1/2 x 6 1/2 x 7 3/8" plywood (or mahogany)	reflector board	M	or 0-50 microammeter—Lafayette TM-70
2 pcs.	3/4 x 3 3/8 x 6 1/2" pine	slide carrier legs	2	magnets, about 1/2" diameter from dime store or Lafayette #F635
SLIDE STAGE ASSEMBLY				
1 pc.	1/4 x 5" x 6 1/2" plywood or plastic	slide stage	1	NE-1 Neon indicator assembly. Lafayette MS-479—yellow
2 pcs.	3/4 x 1" x 3" pine or plastic	stage supports	1	NE-2 Neon type pilot lamp, Jiffi-Lite, Lafayette MS-695 (Mounts in 1/2" hole)
1 pc.	1/8 x 3 3/4 x 4 3/4" masonite	slide carrier	1	Vernier dial, Lafayette #F-346
1 pc.	3 3/4 x 4 3/4"—22 gauge sheet metal (iron) slide carrier	slide carrier	1	Knob with skirt calibrated 1-10. Lafayette #KN-56
LENS BOARD ASSEMBLY				
1 pc.	1/4 x 3 x 5" plywood	lensboard	1	Sockets
2 pcs.	1/4 x 3" diameter plywood	lens tube flanges	1	S0-1 Cinch-Jones, S-404CCT (4 conductors), Allied #40H921
1 pc.	1/8 x 3 3/4 x 4 3/4" Masonite	slide carrier	1	S0-2 Phone jack, Mallory (2 conductors) N.O., Allied #41H054
2 pcs.	1/2 x 1 x 5" pine	lens board supports	1	S0-3 Cinch-Jones D-402 CCT (2 conductors), Allied #40H920
CAMERA DECK ASSEMBLY				
1 pc.	1/4 x 5 x 7 3/4" plywood	camera deck	1	S0-4 Cinch-Jones #78S4—4 Prong socket Allied #40H921
2 pcs.	1/8 x 1 1/4 x 7 3/4" Masonite	spacer/guides	1	Shield for S0-4—Cinch-Jones Allied #16F 40H848
2 pcs.	3/4 x 1 x 3" pine	deck supports	V-1	Kemlite flash head with built-in trigger coil, type C 30° angle, 300 WV, Allied #78E629
1 pc.	1/4 x 2 1/4 x 4 3/8" plywood	camera mount	PC-1	3.50 Clairex CL-4 Photoconductive cell. Lafayette #MS-829 = .95 or MS-855
1 pc.	1/8 x 2 1/4" diameter plywood	spacer ring	Resistors	
2 pcs.	1/8 x 1 1/4 x 1 1/2" hardwood	focusing box	R1	47 ohm, 1 watt carbon 10% tolerance
2 pcs.	1/8 x 1 1/2 x 2" hardwood	focusing box	R2	1 megohm, 1/2 watt carbon 10% tolerance
2 pcs.	1/16 x 1/2 x 7 3/4" brass strip	camera guide	R3	2.2 megohms, 1/2 watt carbon, 10% tolerance
1 pc.	1/16 x 1/2 x 3 1/4" brass strip	camera guide	R4	1 megohm, carbon potentiometer, Mallory Migitar U-52, Lafayette VC-451
2 pcs.	7/16" diameter x 14" threaded steel rods (cut from 36" rod available hardware stores)	camera support rods	R5	1 megohm, carbon potentiometer, Mallory Migitar U-52, Lafayette VC-451
12	7/16" nuts		Capacitors	
4	1/16 x 1 1/4" washers		C1 & C4	8 MFD @ 450 WV electrolytic. Lafayette, C113
1	Used Argus 35-mm camera (or any other 35-mm camera body. Available Bolotin Camera Exchange, 729 W. Roosevelt Rd., Chicago 7, Ill.)		C2	1000 MFD—300 WV, Illinois UMC electrolytic cap. Allied #10L578
FOR PLASTIC ASSEMBLY				
10	2-56 x 1/8" machine screws	camera guides	or	9 Olson Radio C-825, 40-40-40, MFD, 450 WV capacitors connected in parallel to provide 1080 MFD
1	6-32 x 1/2" machine screw	camera stop	C#	.25 MFD @ 200 WV metalized paper Aerovox P82Z Lafayette #CG-262
2	6-32 x 1/2" machine screws	lens board supports	Rectifiers	
4	4-40 x 1/2" machine screws	lens flanges	D1	Silicon power rectifier—500 ma, Lafayette—SP-197
FOR PLYWOOD ASSEMBLY				
10	#3 x 3/8" machine screws	camera guides	D2	Silicon power rectifier—500 ma, Lafayette—SP-197
10	#5 x 1/2" machine screws	camera stop	D3	Silicon power rectifier—500 ma, Lafayette—SP-197
2	#5 x 3/4" machine screws	lens board supports	Switches	
4	#3 x 1/2" machine screws	lens flanges	SW1	SPST Toggle switches, 3A @ 125V, Lafayette #SW-21
20	#5 x 1 1/4" machine screws	case	SW3	SPST Toggle switches, 3A @ 125V, Lafayette #SW-19
1	#5 x 1 1/4" machine screw	reflector	SW4	DPDT Toggle Switch, 3A @ 125V, Lafayette #SW-19
1	4" angle screw hook, brass	reflector base	SW2	Momentary push button switch—N.O. Hart and Here-
ELECTRONIC PARTS (Optional)				
Plugs				
P1	Cinch-Jones, P-404-CCT, 4 conductor, Allied #40H911		SW5	SDST (see schematic) SW-21 Lafayette
P2	phone plug, mallory type 75, Allied #41H641			
P3	Cinch-Jones, P-402-CCT, 2 conductor, Allied #40H910			

hypo, rinsed and dried, and you can get it at any photo store or from your neighborhood portrait photographer. Next, mount the focus light socket on the sheet metal bracket and install. Use a #6 x 1-in. round head wood screw at the rear, and bend a large "L" hook (Fig. 2A) to form a lever at the front.

Cut the two 14-in. rods from a 36-in. length of $\frac{1}{2}$ x 13 threaded rod available in most hardware stores. Bolt in position, using washers on both sides of the wood cabinet top. Saw the slide stage from $\frac{1}{4}$ -in.-thick Plexiglas (Fig. 2B) or hardwood plywood. Cement the supports in place and drill $\frac{1}{2}$ -in. holes for the support rods. If you plan to build the camera unit, cut the lens board supports and camera deck (Fig. 2C) next.

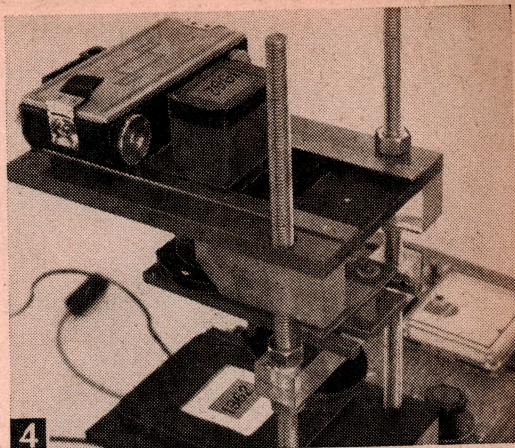
Drill the support rod holes as follows: first drill the left-hand holes in each piece. Take a piece of $\frac{3}{4}$ -in.-thick scrap wood that is larger than the camera deck and drill a hole in one corner, using the $\frac{7}{16}$ -in. bit.

Remove the Camera Deck, lay the next piece to be drilled over the template, and place the camera deck on top. Pin all three pieces together with a dowel or bolt of the same diameter as the support rod— $\frac{7}{16}$ in. You can now drill the right-hand hole by using the camera deck as a guide. Use one of the lensboard support bars as a template while drilling the holes in the case. The method just described may seem tedious, but it assures parallel spacing of the support rod holes—which is absolutely necessary.

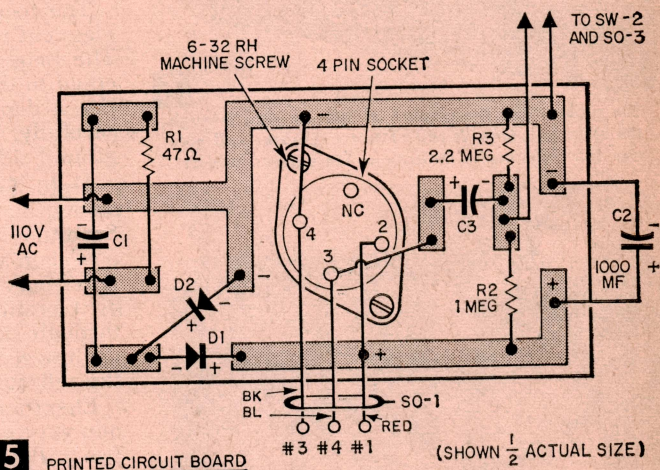
As an alternative, one support rod could be replaced with a cold rolled steel bar to allow better sliding of the sections. But you would need dies to thread the lower portion of the rod. File or drill all left-hand holes slightly oversize to allow the stages to move more freely. The resulting looseness can be "zeroed" by indexing the stages to one side. Tightening the right support rod nuts assures you that the stages will be parallel to each other. The top camera deck is locked by nuts on each column. While this mounting system is not the quickest to adjust, it is accurate, inexpensive, and easy to construct without special equipment.

Cut the slide stage from $\frac{1}{4}$ -in. opaque, black Plexiglas (Fig. 4) or hardwood plywood. Cement the support reinforcements in place and drill the holes for the support rods.

The Camera Deck (Fig. 2C) allows the camera to slide out of the way and a ground glass viewer to be positioned in the exact film location. This entire assembly will not be needed if you own a 35-mm reflex camera.



The camera box is mounted on a sliding plate along with a ground glass focusing panel.

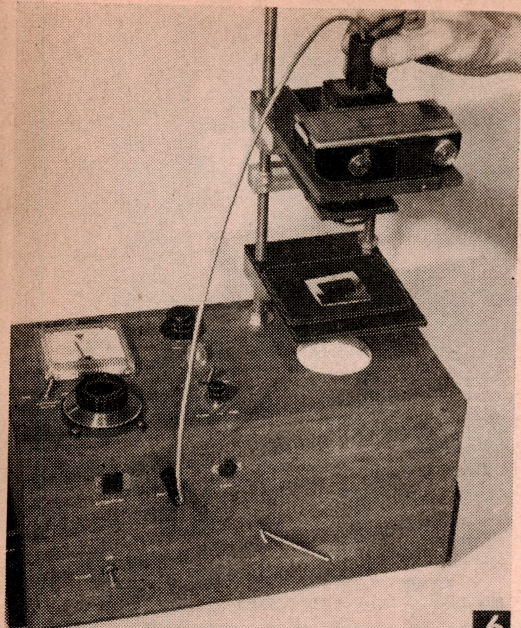


PRINTED CIRCUIT BOARD

(SHOWN $\frac{1}{2}$ ACTUAL SIZE)

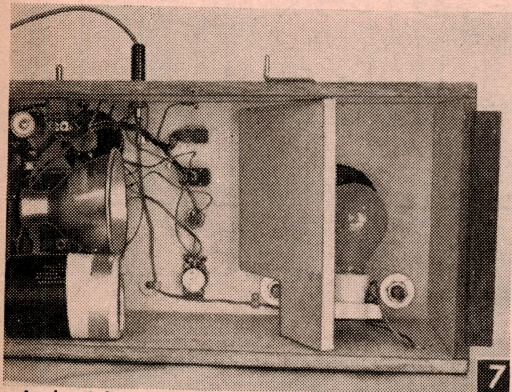
The camera shown is an early model Argus purchased by the author for \$3.50 in a camera store. The camera shutter was inoperative but is not needed since the disc mounted on the post acts as a shutter or lens cap. Any similar 35-mm camera can be used. The 50-mm focal length lens originally supplied with the camera produced passable slides. A better choice, however, would be an enlarging lens of 90-mm focal length. Such lenses are corrected for working at close distances.

Separate camera from the lens and mount the body parts on the plate (Fig. 2C). Use the holes in the camera lens flanges as a drill template. Fasten the lens mount in place with screws the same diameter as originally used, but longer. Next mount the lens on the lens stage. The lens stage extends behind the vertical rods and has slots instead of holes at its mounting ends. This allows it to be aligned with the camera deck aperture. Cut the guide tracks from $\frac{1}{16}$ x $\frac{1}{2}$ -in. brass strip.



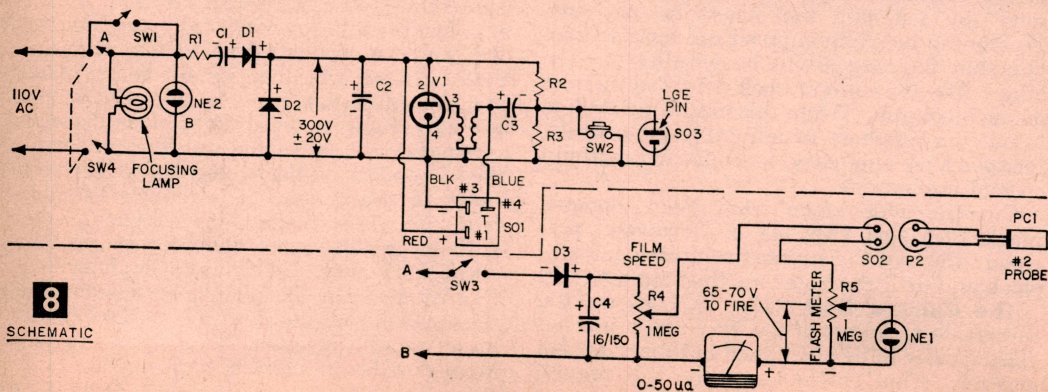
6

The probe reads the amount of light passing through the slide and lens. A roll of test exposures will give you the right meter indications for various subjects.



7

At the right is the reflector and focusing lamp assembly. The electronic flash assembly is mounted on a circuit board at the left.



8

SCHEMATIC

Mount the brass strips on the camera deck with two 56 x 1/2-in. brass flat head machine screws. If you use wood in place of plastic, use #4 x 1/2-in. wood screws. Paint the slide surface flat black, and paste black velveteen on the underside of piece "A," to serve as a light trap.

Make the Extension Tubes of telescoping cardboard mailing tubes with the larger ones about 2 in. id. If you lack telescoping tubes, cut a gap in one of the tubes so that when the gap is closed it fits snugly inside the other. Glue the gap, cover the slit with black paper and paint both tubes matte black.

Drill the lens tube mounting flanges to clear 6-32 machine screws. Use the flanges as templates to drill the holes on the lens board and camera deck. Tap the holes, cement lens tubes into flanges, and complete the assembly. Several sets of lens tubes may be needed for various lenses.

The focus panel is a piece of fine ground glass cut to fit the outside of the box section. The height of this section must be exactly equal to the height of the camera film plane. Use a depth gauge to check this dimension carefully. Then cement the ground glass with ground side facing the camera lens.

Light Sources. The least expensive approach would be to use a 3200° K reflector flood mounted at the left end of the case on a porcelain socket. In operation, you burn the flood only during actual shooting with the light beam bouncing off the 45° reflector up through the slide. To save the flood lamp, use the second lamp mounted on the back of the reflector board for focusing.

Electronic flash offers the advantage of a non varying light source. If you own an electronic flash unit, you can simply cut a hole for the reflector on the left side of the case. Or you can build your own electronic flash unit and light meter (Figs. 6, 7). Besides slide duplication, the flash reflector can be used with an extension cord for close-up photography. The pattern (Fig. 9) can be used as a master to print the circuit board. Or you



9 Cropping can improve most slides. The original slide (left) was copied at about a 2:1 ratio to eliminate unwanted background and to enlarge interesting detail. You can also use this method to call attention to one part of a scene. A quality lens and good original slide will permit enlargements up to 10 X without serious color loss.

can use the tape resist method of producing the board, or a terminal board.

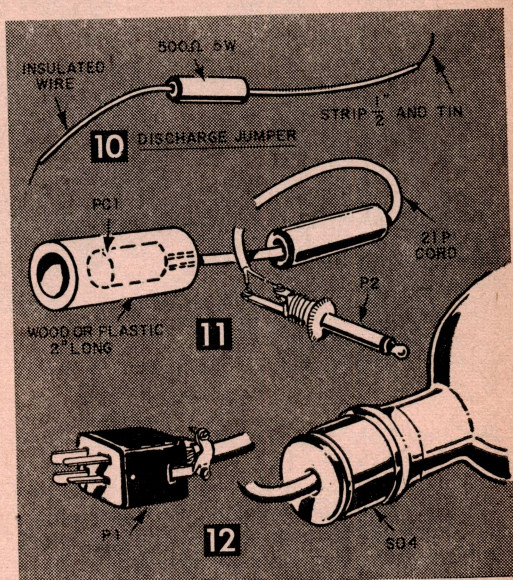
Mount all circuit components and solder. Fasten the flash lamp in place with two 6-32 x 1/4-in. nuts and bolts. Connect socket terminals to the board with short wire jumpers. Use 1-in. lengths of copper or plastic tubing as spacers. Then mount meter and all other parts on the case.

To mount the vernier first fit a sheet metal bracket to the potentiometer. Fasten the vernier to the case with 1/2-in. wood screws and then fasten the metal bracket to the case with a 1/4-in. wood screw. The bracket must be positioned to point at 12 o'clock. Turn the vernier dial to zero, and if the pot is not at full rotation, remove and readjust the assembly.

Test the Assembly after checking all wiring. Plug the unit into the ac line. Turn SW-4 on and the focus lamp should light. Then turn SW-1 on. (If there is any smoke or sizzle you have a short in the unit. Turn power off immediately and check the circuit.) After several minutes, push switch SW-2. You should get a bright flash. If you don't, you have an error. Re-check wiring.

Never touch any part of the circuit wiring once the unit has been plugged in! First unplug the power cord. Use the discharge jumper (Fig. 10) to discharge the capacitor. Energy in the capacitor, when fully or even partly charged, can be lethal. Only after the capacitor is completely discharged can you attempt to touch circuit parts.

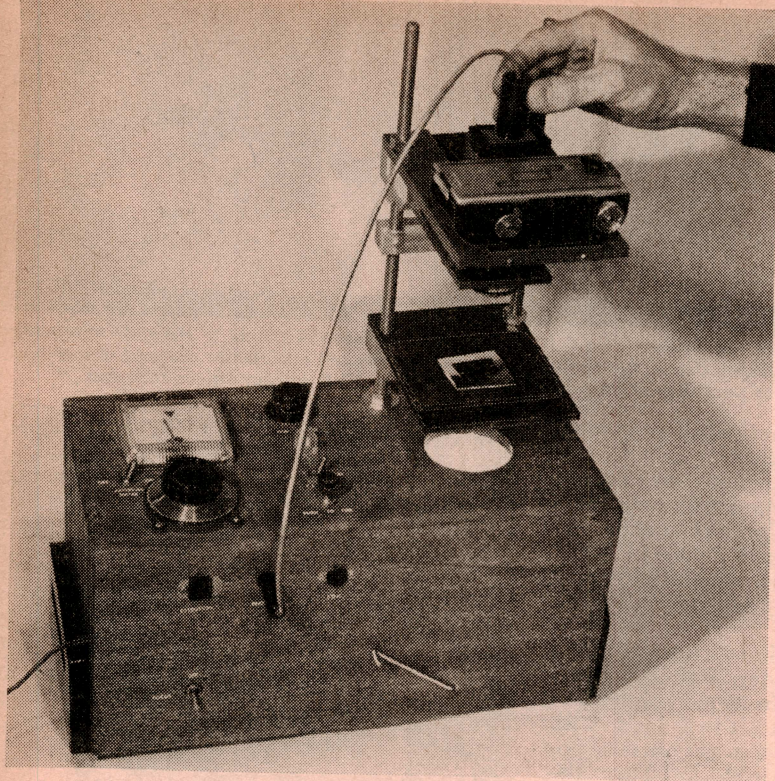
If you do not get a flash when you trigger the unit, read voltage across the capacitor. Attach your voltmeter leads before turning on the power. Set the meter on dc for 300 volts or higher. Don't handle leads until the unit is unplugged and the capacitor discharged! Correct operating voltage is 300 volts. If you do not get 300 volts at the capacitor, you should disconnect it (after discharging) and re-check the voltage on the circuit board. If 300 volts is there the capacitor may be bad. If you don't get the proper voltage, you have either a bad or misplaced



component or a poor solder joint.

To check the exposure meter, plug in the probe and turn on SW-3. The meter should swing up/scale. Shield the probe from light; the meter should drop down/scale. Turning the film speed dial clockwise should cause the meter reading to increase. If it drops, reverse leads to the film speed potentiometer. With SW-5 meter off, turn the vernier dial back and forth. At some point of its position, the neon lamp (above the meter) should light and then go out when the probe is shielded from the light.

An increase of light should cause the neon indicator to light when the vernier is set close to the proper set point (about 65 to 70 volts across the slider on the potentiometer and the ground lead). Turning the vernier dial to the right should cause the neon indicator to light. If the light operates, but goes out when the dial is turned up, reverse the leads to the outside terminals of the potentiometer.



To determine exposure, focus camera at desired size ratio. Shoot and process test roll. Determine best exposure for average slide. Set diaphragm to working aperture and turn film speed dial so meter needle coincides with arrow. This is setting for average slide copy at any ratio. Read flash exposures by adjusting lens until flash just fires neon lamp.

Making Color Duplicates. Working with electronic flash as a light source on our unit, tests showed *Daylight Anscochrome* to be the best all-around film for amateur duplicating. This film has wide exposure latitude, good color rendition, excellent definition and moderate film speed, ASA-32. The film can be used in two ways: you can shoot copies on the regular roll that you use outdoors and order normal processing; or you can decrease contrast by having the finishing lab cut both first and second developer times to 12 minutes. Exposure tests will have to be made either way, and to use the film for duplication you will need a Wratten #81-A filter. *Daylight Anscochrome* emphasizes the green and blue tones.

A film designed especially for duplicating is *AnSCO Duplicating Film #547*. This color dupe film costs only one-third that of regular color camera film, but is sold only in 100-ft. cans and must be ordered specially through your dealer. If you choose it, you will have to store the film in a cool place and spool it on your own film cassettes. It can be processed with the same developer as *Daylight Anscochrome*, but use 12 minutes in the first developer instead of 16½. The film is color balanced for 3000°K and should be used with a UV 16 P (AnSCO) ultra-violet filter and a Wratten #85B conversion filter. Speed is

about ASA 8 when used with the recommended filters. The key advantage is that it has less contrast than regular camera films and thus is capable of producing duplicates of better tonal value.

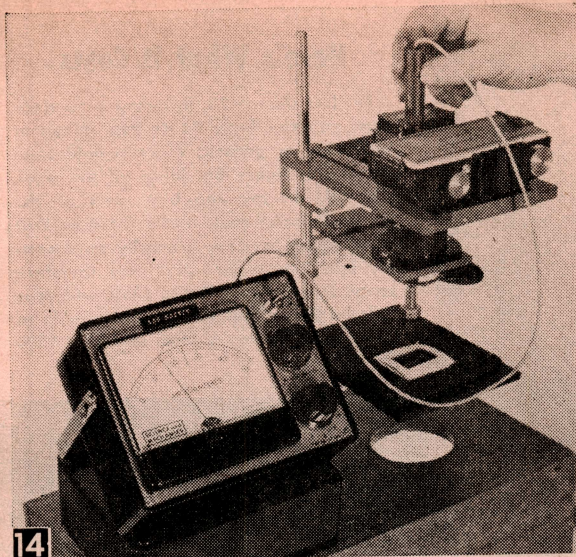
(Editor's Note: Ansco has recently announced a new film process. Development at 80° will reduce total developing time from 85 to 44 minutes. New developing times will be included with processing kits that can be used with amateur equipment.)

Daylight Ektachrome Type E-2 is another film you can process yourself or have developed by your local color finisher. It should be used with a Wratten #81-A filter. E-2 tends to emphasize the warmer red and orange colors.

Ektacolor 35-mm Film has a speed of 8 to 10 ASA when developing time is reduced to 9 minutes. Use a Wratten #85 filter. When you order prints, be sure to tell the dealer that the slide copies were shot with electronic flash.

These are the major films available today. Other makes of film can be obtained, but it is best to start with materials that are readily available and to perfect a technique for getting the best results from one film rather than to skip from one to another.

Filters are needed in slide duplication to



Supersensitive light meter also can be used to read ground glass exposure. Establish average exposure with test roll, note meter reading, and set film speed knob to arrow. Slides may be read on basis of average tone or minimum density.

example, cyan holds back red; magenta holds back green, and yellow holds back blue. Thus if your original slide is too blue, use a yellow filter.

You use the filter density numbers when you want to change from one filter pack to another. For example, let's say that you ran a preliminary test roll with Ansco Dupe Film type 547. Along with the conversion filter and an ultra-violet filter, you decided to use a 30 Y and a 30 M. The roll was developed and your test slide was correct for exposure but off-color.

Look at the Slide through various combinations of CC filters. Maybe it looks just right when viewed through a 10C and 05M. In other words, it was too red and just a little too green. We could add these filters to our filter pack but would end up with so many filters the exposure time would be lengthened too much. Instead list all the filters on scratch paper as follows:

Original filters	10C	30M	30Y
Viewing filters	10C	05M	
Total	10C	35M	30Y

We add the densities as above, and then subtract 10 from each column; your filter pack will then consist of only a 20Y and a 25M (20 and 5) filter.

Professional photographers often start out by shooting a duplicate by the "ring-around" method. They use a test slide, preferably one that has sample colors as well as flesh tones and grass and sky colors. A test roll is shot, one picture each with a 05Y, 05M, 05C filter. Then another series each is exposed with the 10 and 20 series filters. After the roll is processed, the best duplicate indicates the setup for the majority of slides, unless, of course, you wish to correct for objectionable color cast in the original photo.

A European system has been introduced that may offer the color photographer a more convenient approach. Called the *Decamired* system, the name stands for Deca (meaning 10) and the word *mired*, representing 1 million, divided by degrees Kelvin. As an example, a photoflood lamp rated at 3400° Kelvin would be converted to Decamired value by dividing 1 million by 3400. The result, 294 mireds divided by 10 (Deca), gives you a Decamired Value of 29.

Light sources are rated in terms of Decamired numbers; so are filters and films. You subtract the Decamired number of the light from that of the film, and that difference indicates the proper filter.

control the color of the light source. There are two main kinds of filters: conversion filters and color compensating filters. The conversion filter adapts a color film designed for one kind of light with another for use with another type of light source. Examples were given above, in the list of films.

Color Compensating Filters correct undesired tints of color. Both Kodak and Ansco market similar sets of color filters (Table A). They are available in sets of seven filters for each color. The 4x5-in. size is recommended for use with the slide reproducer. The number in front of the letter is directly proportional to the color density. Each filter in the series has twice the density of the filter listed above it.

The color a filter holds back is the complementary color of the filter itself; for

TABLE A

Yellow	Magenta	Cyan
025Y	025M	025C
05Y	05M	05C
10Y	10M	10C
20Y	20M	20C
30Y	30M	30C
40Y	40M	40C
50Y	50M	50C

TABLE B

Color of slide	Add	or	Subtract
Yellow	Magenta & Cyan		Yellow
Magenta	Yellow & Cyan		Magenta
Cyan	Yellow & Magenta		Cyan
Blue	Yellow		Magenta & Cyan
Green	Magenta		Yellow & Cyan
Red	Cyan		Yellow & Magenta



Here's What It Costs

For less than \$175, including a new engine, you can have Pow'r Pup rolling in your yard or garden. You can hold costs below this figure by doing all the work yourself, or you can buy some of the harder-to-make components listed so that construction becomes primarily an assembly job. Your actual cost may therefore range from below \$175 to \$350, and your finished Pow'r Pup will be comparable to commercial garden tractors selling at \$500 to \$600.

POW'R PUP

Suburban Tractor

**Will: mow the lawn—haul leaves—do light grading—
bulldoze snow—roll the lawn—plow garden—pull a disc
or harrow—cultivate crops—pull a seeder—tow a sled**

By S. S. MINER

NOT a toy, but a real man-sized tool, the *Pow'r Pup* goes a step beyond the straddle-type tractors now in widespread use and brings to the home workshopper, for home construction, a rugged, simple, and economical machine for yard and garden work—and for leisure enjoyment too. Many Sears tractor attachments will fit it, and you can build it for \$175 or less.

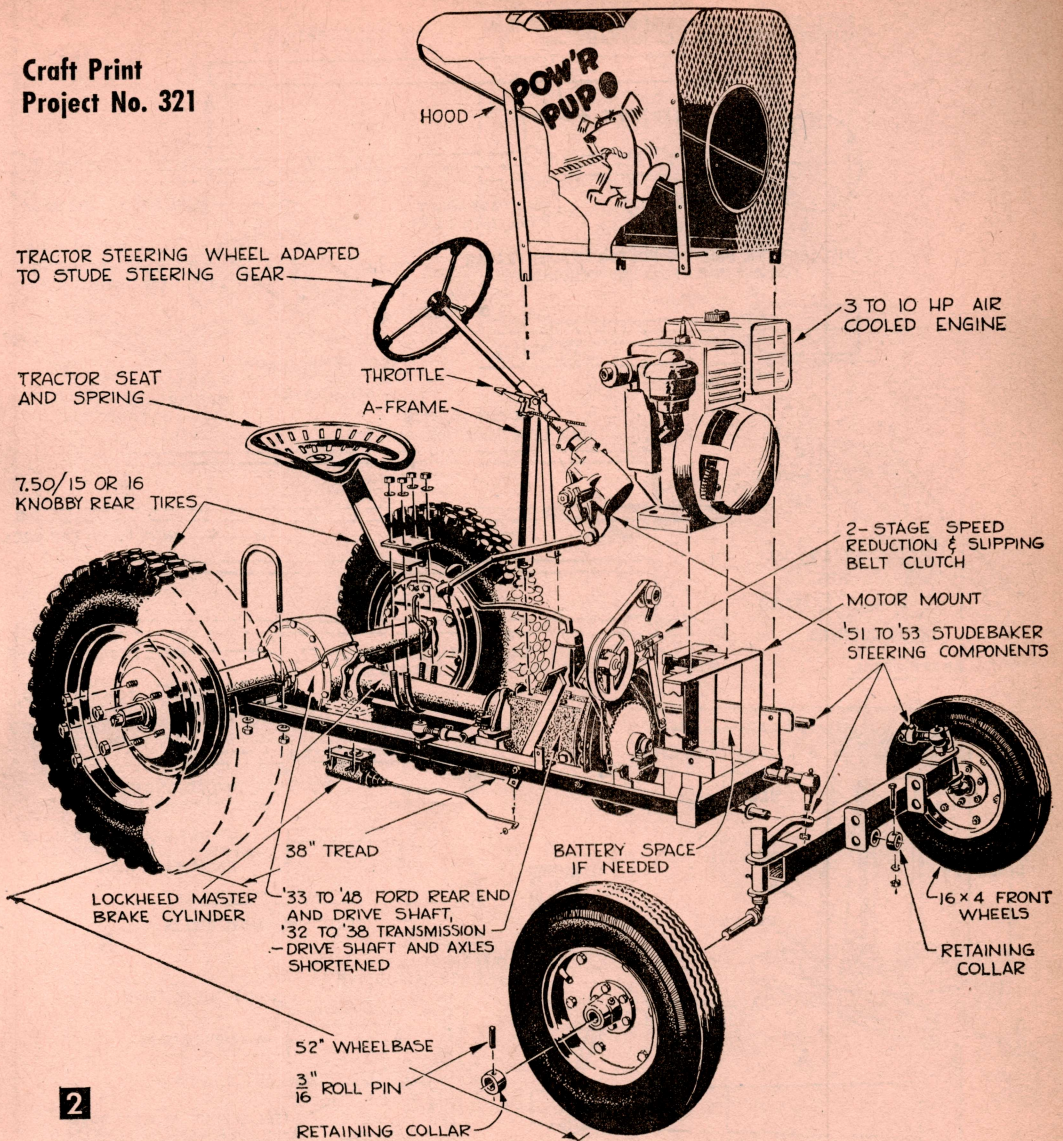
Based on used car parts (widely available in junk yards) and various components from Sears Roebuck Co., it is extremely stable and maneuverable. With three speeds forward plus reverse, it will do any job from light hauling to heavy plowing. The design calls principally for cutting, drilling, and welding operations. By special arrangement, a sup-

plier has been established for components you may wish to buy rather than make (see Materials List).

The design is flexible enough to permit a wide choice of automotive parts: you could base a small tractor design on almost any manual-shift transmission and symmetrical rear end, and many small air-cooled engines from 3 to 10 hp would be suitable. However, any departure from the design given here will require careful study of the problems involved. If you make changes, keep in mind that the ready-made parts listed will fit only the *Pow'r Pup* as designed.

Your First Step in building the *Pow'r Pup* is to locate the used drive-train parts from the right vintage Ford. These need not be in first class condition when you buy them and probably will not be, but be sure you get, from one source or another, all the essen-

Craft Print Project No. 321



tial parts: a transmission, driveshaft and housing, universal joint and joint cover, and rear end complete with drums and internal brake parts. Lay all this loot out on the ground somewhere and clean off the outside (it will probably be pretty dirty) with a putty knife and kerosene, or use a commercial degreaser.

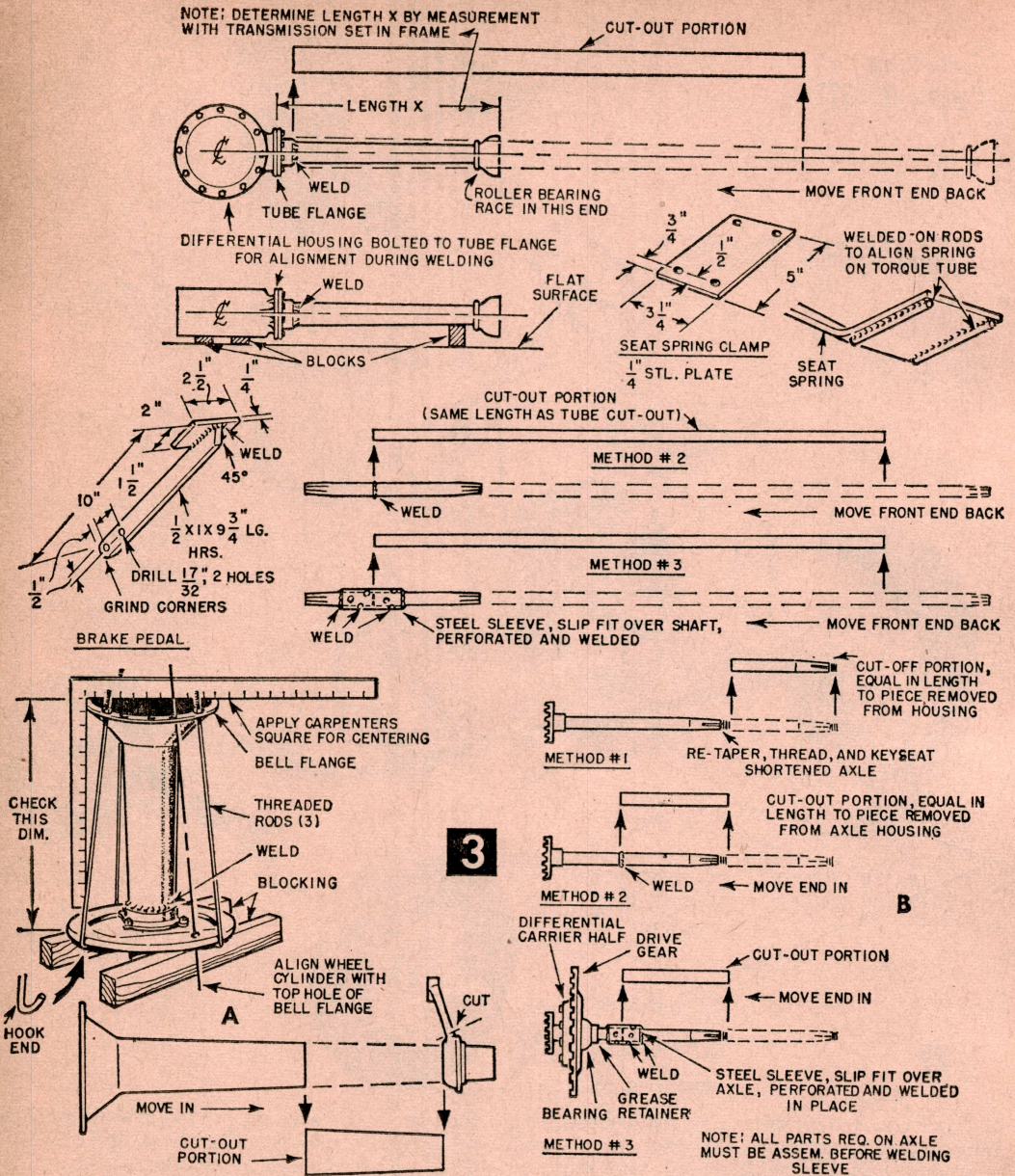
Before taking the parts into your workshop drain the rear end and transmission. Then remove the two axle housings from the differential housing. In these earlier Fords, the bevel pinion gear at the inner end of the axle shaft is forged directly on the end of the axle itself, hence the axle housing must be removed from the differential housing, and the differential carrier must be taken apart in order to withdraw the axles. Disassemble

the rear end, clean up the axles and housings preparatory to working on them, and unfasten the backing plates and lay them aside.

First Job is to Cut the spring perch arm (Fig. 2B) off each axle housing. Hack saw it as close as possible to the housing bolting flanges. Then cut a section out of the axle housing itself close to the bolting flange (Fig. 3A) with a hack saw, or in a power cut-off saw if one is available. The amount to be removed will depend upon two things: the rear wheel tread of the original car, and the tractor tread width desired. Half the difference between these two dimensions is the amount to cut out. Make these cuts at 90° to the centerline of the housing.

Check one of the brake backing plates to see that it is not bent, then bolt the cut-off

SURPLUS and SALVAGE PROJECTS



housing end to it. Support this on blocking and clamp the axle housing in assembled position with three 1/4-in. rods, hooked at one end and threaded at the other (Fig. 3). Check with a carpenter's square and steel tape to determine parallelism and proper centering of the backing plate and bell flange. Be sure to align the wheel cylinder opposite one hole of the bell flange so that when assembly is completed the wheel cylinders will be at the top on each side.

An alternate alignment method is to clamp the bell flange of the axle housing to the face plate of a large lathe and support the cut-off housing end in aligned position on an arbor.

In either case, once proper alignment has been achieved, weld the two parts together, tack-welding first on opposite sides to avoid distortion. Shorten both axle housings in this manner.

There are Three Methods (Fig. 3B) for shortening the axles themselves: 1. Cut them off to the desired length, retaper and thread the ends; 2. Cut a section out and butt-weld the remaining portions together; and 3. Cut a section out, slip a perforated sleeve over the cut ends, and weld together. For the amateur the third method is easiest but has the disadvantage (with the Ford axle) that the inner shaft bearing and other parts must be

slipped over the axle before the sleeve is welded on, and they can never be removed. The second method is best for those with the necessary welding skill but no lathe.

Choose the method best suited to your skills and tools, then shorten both axles by the same amount that you shortened the housings.

Similar problems will be encountered in shortening the driveshaft and torque tube. The front end of the Ford torque tube contains a roller bearing race; therefore the portion removed must be back of this, preferably at the rear end of the tube (Fig. 3). Bolt the rear tube-flange to the differential housing and lay the assembly on a flat surface to secure proper alignment while welding.

Since both ends of the Ford driveshaft are splined, the method chosen for shorten-

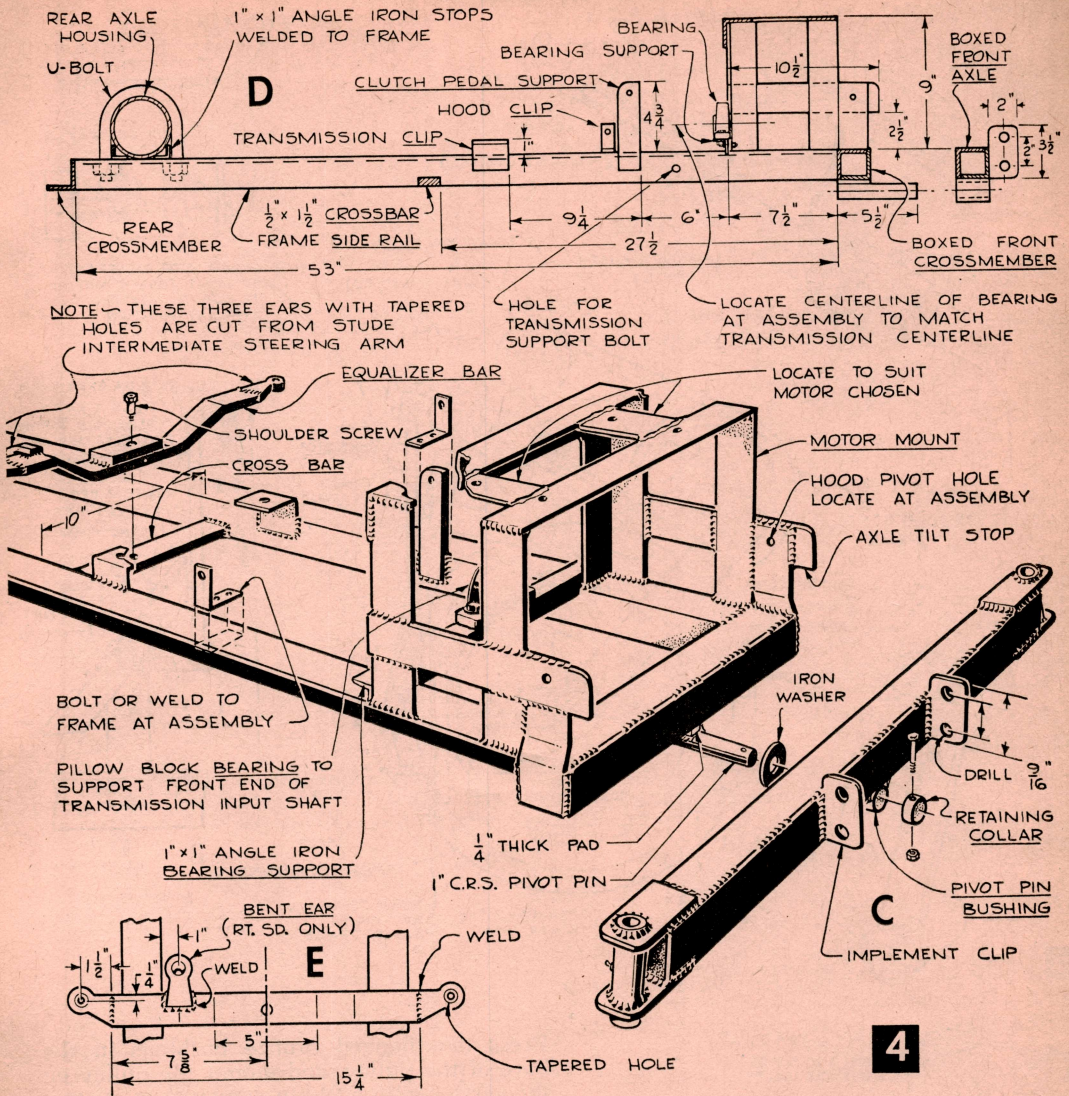
ing it will probably be #2 or #3 (above), rather than #1, to avoid the problem of re-splining a cut-off end. The sleeve method will be satisfactory for this shortening operation as it will not interfere with assembly or disassembly. Remember to remove the same amount from the shaft as from the tube.

After the shortening operations are completed, coat all parts with a film of grease and reassemble. Now, before going further with the reassembly, check the brake drums, shoes, and cylinders—these will probably need reconditioning. Worn shoes can be relined or replaced (see Materials List), and scored drums can be turned at your local automotive repair shop. Finish the assembly of the rear end after overhauling the brakes.

Next Job is the Frame (Fig. 4). If you are going to take this part of the job to a com-

MATERIALS LIST—POW'R PUP

Amt. Req'd	Size and Description	Amt. Req'd	Size and Description
STEEL			
21 ft.	2 x 2 x 1/4" angle iron . . . for frame, front axle, brackets	1	tractor seat spring, Sears #1248H
8 ft.	1/4 x 2" flat HRS . . . for motor mount, spindle supports, brackets	1	tractor steering wheel, Sears #606A63
1 ft.	1/4 x 4" flat HRS . . . for steering bracket, seat clamp	2	front wheels, 4 x 8 run. 16/4 tires and tubes, Sears #606H23
9 ft.	1 x 1 x 1/8" angle iron . . . for A-frame, axle stops, trans. bearing, toggle support	1	5.75 hp David Bradley engine, Sears #32A3067L or #32F9823L
12 ft.	3/16 x 1" flat HRS . . . for hood	2	3 x 3' aluminum sheet (plain, for hood) Sears #99A7320N
20 in.	1/4 x 1" flat HRS . . . for toggle, pivot pin pad, clutch	1	2 x 2' piece 1/2" expanded metal for grille
20 in.	1/2 x 1" flat HRS . . . for clutch, brake	1	starter kit (if desired) for David Bradley engine including starter and battery, Sears #F32F9822L
6 ft.	1/2 x 1 1/2" flat HRS . . . for equalizer bar and support, clutch support, jack shaft parts	USED AUTOMOTIVE PARTS	
5 1/2 in.	1" round CRS . . . for axle pivot pin	1	'32-'48 Ford rear end, with brake parts and drums, torque tube, drive shaft, universal joint and cover
14 ft.	3/8" round HRS rod . . . for hood, brake, clutch, steering	* 1	'32-'38 Ford transmission (or '39 to '48 side-shift model)
4 ft.	1/2" round HRS rod . . . for U-bolts, seat spring stops	* 1	Lockheed (or similar) master brake cylinder with tee fitting and lines
22 in.	3/4" I.D. x 1 3/8" O.D. tubing . . . for spindle bushings and collars, steering adapter	1	steering gear (from '51 through '53 Stude) including shaft, gear box, pitman, connecting rod, tie rods, knuckle arms, six tie rod ends, and ends of intermediate arm
1 in.	1" I.D. x 1 1/2" O.D. tubing . . . for axle pivot pin collar	* 2	15" or 16" Ford wheels
2 ft.	1/2" black iron pipe . . . for steering rod extensions	* 2	7.00/15 or 16 tires and tubes (knobby thread preferred)
2 1/2 in.	1 3/8" I.D. x 2 1/4" O.D. tubing . . . jack shaft arm	* Obtainable from Sears, also the following optional items: wheel cylinders, brake lining sets, brake lines and fluid brake drums, Alkyd spray enamel and primer, motor degreaser, motor oil, transmission grease, lights, switches, wiring, perforated aluminum (for grille).	
MISCELLANEOUS PARTS		TRACTOR PARTS	
1	60 tooth 1/2" pitch (#40 chain) sprocket, Boston Gear #SKSB60 . . . for drive, 2nd stage	Tractor parts obtainable from: Salay Speed Equipment, 1851-53 Prairie Ave., South Bend 14, Indiana—all prices include materials—F. O. B. South Bend—	
1	15 tooth 1/2" pitch (#40 chain) sprocket, Boston Gear KSB15-1 . . . for drive, 2nd stage	Item	Price
40 in.	1/2" pitch, #40 single Boston Gear roller chain with connecting link . . . for drive, 2nd stage	Drive shaft: cut, re-splined	\$ 8.50
1	2 1/2" cast iron V-belt pulley, A size, 7/8" bore, Sears #9A2882 . . . for drive, 1st stage	Drive shaft housing: cut, welded	8.50
1	6" cast iron V-belt pulley, A size, 3/4" bore, Sears #9A2886 . . . for drive, 1st stage	Rear axle (R & L): cut, threaded, key-seated, threaded	10.50 ea.
1	A-section V-belt, Sears #9A1630 . . . for drive, 1st stage	Rear axle housing (R & L): cut, welded (no backing plates, brake parts)	10.00 ea.
6	Bronze thrust washers, Boston Gear #TV-1228 . . . for spindles	Rear end center section: with gears (as is)	3.00
2	Flanged bronze bushings, Boston Gear #FB-1012-6 . . . for jackshaft	Front wheel spindle (2 req.): bent, welded-on washers, with bronze washers (3), retaining collars, & steering arm bushings	5.00 ea.
8	3/16 x 1 3/8" roll pins . . . for adaptor, spindles	Front axle: weldment, with spindle bushings, clips, pivot bushing, retaining collar	15.00
1	5/8 x 2 1/4" shoulder screw . . . for jackshaft pivot	Frame: weldment, with motor mount, crossbar, clips, holes	28.50
1	1/2 x 1" shoulder screw . . . for equalizer bar pivot	U-bolts: (2 rear axle, 2 seat)	2.00 ea.
1	5/8" bore self aligning pillow block Boston Gear type BNS (or similar) . . . for trans. input shaft	Seat spring clip: drilled	1.75
2	speed controls, Sears, #32F3020 . . . for gas and choke	Steering equalizer bar: bent, center pad welded and drilled, no rod end ears	3.50
6	3/8-24 x 1/4" hex head screws . . . for hood, steering brackets	Steering column adapter: tube, counterbored	1.00
6	3/8-24 x 2" hex head bolts & nuts . . . for engine, trans., clutch	Main drive sprocket: broached	12.00
1	1" I.D. iron washer . . . for axle pivot pin	Jackshaft arm and carrier: welded, slotted, drilled	5.00
1	1/4-20 x 2" hex head bolt & nuts . . . for axle pin collar	Intermediate sprocket and pulley: shouldered, with sprocket bored and brazed on, bronze bushed	10.00
4	1/2-13 x 1" hex head bolts and nuts . . . for trans., steering	Implement hitch adapter: rear, angle iron, drilled and welded	5.00
8	1/2-13 hex head nuts . . . for U-bolts		
36	#10-24 x 1/2" rh screws and nuts . . . for hood, throttle		
1	tractor seat, Sears #1415M		



welding in pieces of 1/2-in. pipe. Cut the connecting rod and weld in a 6-in. piece of 3/8-in. rod bent to a 10° angle.

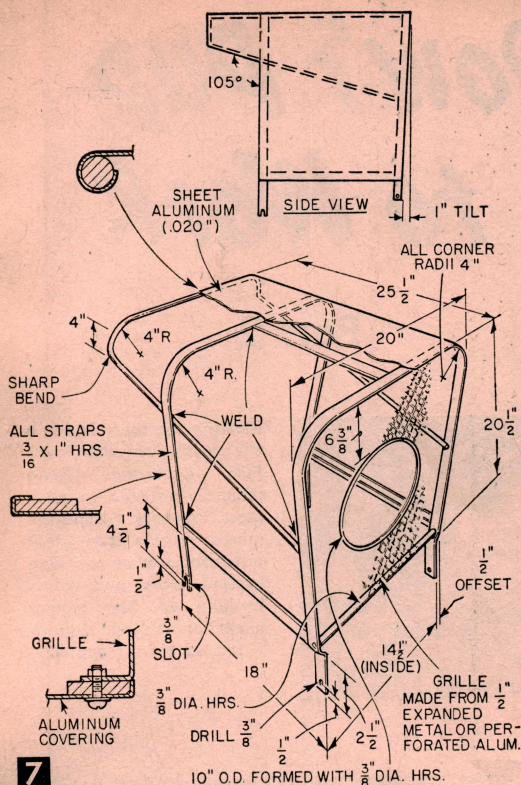
Cut the pitman arm in two, lap it, and weld it to a 4-in. radius. Make the equalizing bar of 1/2 x 1 1/2-in. HRS. Weld the cut-off ends of the Stude intermediate steering arm to the equalizer bar, making certain you get the tapered holes big end up (Fig. 4E). Make the steering gear bracket and fasten it to the transmission housing in place of the old inspection plate. Cut the Stude steering column off 1 1/2 in. above the steering box, make the adapter to take the Sears steering column, and drill for 3/16-in. roll pins. The adapter will just fill the space between the steering box and the A-frame sleeve, a piece of 3/4-in. I.D. tubing welded to two pieces of 1 x 1 x 1/8-in. angle iron (Fig. 6). Assemble the steering

mechanism, adjust the drag link length to produce a 25° knuckle arm angle (Fig. 4A), and pin the knuckle collars to the spindles with two 3/16-in. roll pins each. This operation should be performed with steering wheel centered and front wheels pointed straight ahead.

The Drive Mechanism is a two-stage reduction lowering engine speed (3600 rpm) to 375 rpm at the transmission input shaft. The V-belted first stage functions as a clutch; the second stage is chain, for high torque. Make the jackshaft arm (Fig. 5A) out of 1/2 x 1 1/2 HRS welded to a piece of 2 1/4-in. O.D. x 1 3/4-in. I.D. steel tubing. Make the jackshaft carrier out of the same 1/2 x 1 1/2 HRS stock. Turn a shoulder on the hub of the 6-in. diameter V-belt pulley to receive the 15 tooth sprocket (which will have to be bored out for this purpose) and braze the sprocket in place.



With a 5.75-hp engine, the Pow'r Pup makes light work of a heavy job, turning an 8-in.-wide furrow 8 in. deep in medium sod with the Sears 6-in. plow.



position it on the mount according to Figs. 2 & 5. With other engines it will be necessary to check clearances on all sides of the engine and alignment of the drive pulley with the jackshaft pulley before drilling the mounting holes.

To avoid interference with the grille, make a diagonal extension for the air cleaner (Fig. 2) if your engine requires it.

Make the Hood Frame (Fig. 7) of $\frac{3}{16}$ x 1-in. HRS and $\frac{3}{8}$ -in. HRS rod bent and welded together. Cover it with sheet aluminum (see Materials List) carefully bent around the frame and secured at the bottom with #10-24 *rh* screws and nuts. Trim the metal far enough from the frame edge so you can form it around the frame members to finish off and secure it. Make the grille of $\frac{1}{2}$ -in. expanded metal, or perforated aluminum sheet, and secure it in place with #10 *rh* screws $\frac{1}{2}$ in. long, and nuts.

Make a 10-in. diameter ring of 1/4-in. or 3/8-in. steel rod and braze it to the surface of the grille, centering it laterally and positioning it vertically so as to clear the starting mechanism of the engine. Then cut out the portion of the grille inside the ring, hammer down the cut edges and cover them with braze where necessary. If your grille is aluminum, simply trim it about 3/4 in. inside the ring and form it back over the ring.

Place the Hood in position on the tractor and push it backward far enough so the starter pull rope is freely accessible through the grille opening, then mark for, and drill and tap, the hood pivot-bolt holes (Fig. 4D). Then locate and bolt on (or weld) the rear hood support clips (Fig. 4).

Make the brake pedal (Fig. 3), of $\frac{1}{2} \times 1$ -in. HRS and pivot it to the right side of the frame. Mount a Lockheed (or similar) master cylinder well back on the frame and make a $\frac{3}{8}$ -in. diameter brake push rod to connect the pedal with the cylinder. Connect the master cylinder by means of regular steel tube brake line, including a tee fitting, to both rear wheel brake cylinders.

Install a throttle control (see Materials List) on the A-frame and connect it to the engine carburetor. Use a similar control for the choke, if desired.

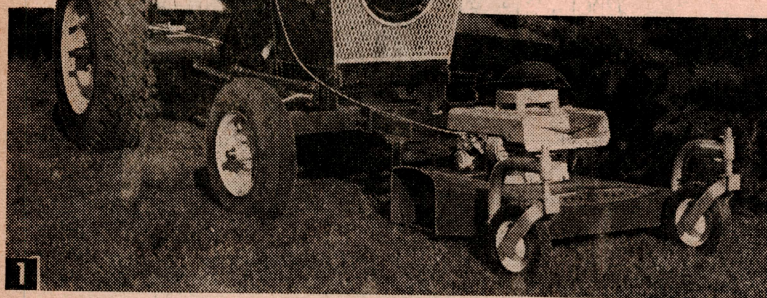
This Completes the Mechanical Work on the Pow'r Pup. Now clean up the whole machine and paint it with good quality machine enamel (see Materials List). Before starting the tractor, service it completely.

The following article will tell how to make and use the various attachments the Pow'r Pup is designed for.

● Craft Print No. 321 in enlarged size for building Pow'r Pup is available at \$2. Order by print number. To avoid possible loss of coin or currency in the mail, we suggest you request by check or money order (no CODs or stamps) to New York Div. of SCIENCE and MECHANICS, 505 Park Ave., New York 22, N. Y. Please allow three to four weeks for delivery. Special quantity discount! If you order two or more craft prints (this or any other print), you may deduct 25¢ from the regular price of each print. Hence, for two prints, deduct 50¢; three prints, subtract 75¢, etc.

Putting Pow'r Pup to Work

Part 2



Mowing the lawn is not a chore—it's fun with Pow'r Pup. Castoring wheels make it possible to push most mowers. Separate mower engine is a great advantage when working around trees and when backing up. The mower keeps on cutting, regardless of tractor speed.

WHEN you have completed the mechanical work on Pow'r Pup, as described in the preceding article, there is one additional feature, the rear wheel fenders, that should be added. These protect you from being jostled against the wheels when riding on rough or muddy ground.

Make them out of $\frac{1}{2}$ -in. black iron pipe (Fig. 5A), covered with sheet metal. After cutting the pipe to the required lengths, bend the four long pieces with a plumber's hickey to the radius shown. File or grind the ends of the transverse pieces to fit between the curved upright members and weld them in place.

Make the four $\frac{1}{4} \times 2$ -in. hot rolled steel clips and bolt them to the bottom ends of the fender frames. Then weld the clips to the brake backing plates, positioning the top pipe of the fender frame about 1 in. above the tire. Cover the frames with 16 gage black iron sheet, securing it with $\#10 \times \frac{1}{2}$ -in. self tapping screws. Smooth up all rough edges on the fenders, then paint them to match the tractor.

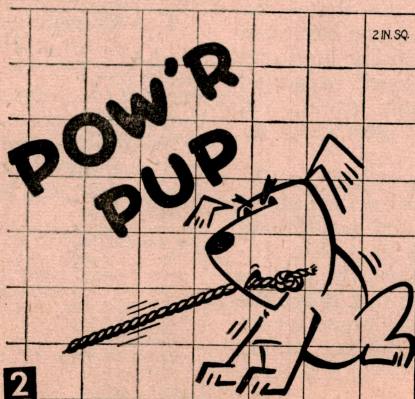
You Can Use Pow'r Pup with a variety of

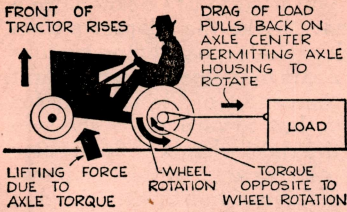
plows, mowers, and other gardening tools already on the market, many of which are available second hand. For lawnmowing, either pull or push-type reel mowers or rotary mowers can be adapted for use. Fig. 1 shows a Sears Roebuck 24-in. rotary mower attached to the front axle of the tractor with the hitch in Fig. 5C. Several Sears mowers can be used with this hitch or with slight modifications of it.

Make this hitch of $2 \times 2 \times \frac{1}{4}$ -in. angle iron, cut, drilled, and welded as shown. Attach the Sears mower to it with the $\frac{1}{4} \times 2$ -in. HRS strap. The clamping plates (Fig. 5C) permit the mower to be lined up with either the left

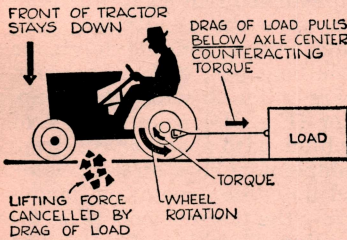
or right wheels of the tractor for cutting along shrubbery and walls. The front end of the Sears mower is supported with two castoring forks and brackets (see Materials List) bolted to the holes originally provided for the adjustable mower wheels. The mower wheels themselves can be mounted in the forks, using $\frac{3}{8}$ -in. bolts as axles. Lead the mower throttle control back to a convenient point on the hood, as seen in Fig. 1.

Rear-Attaching Imple-

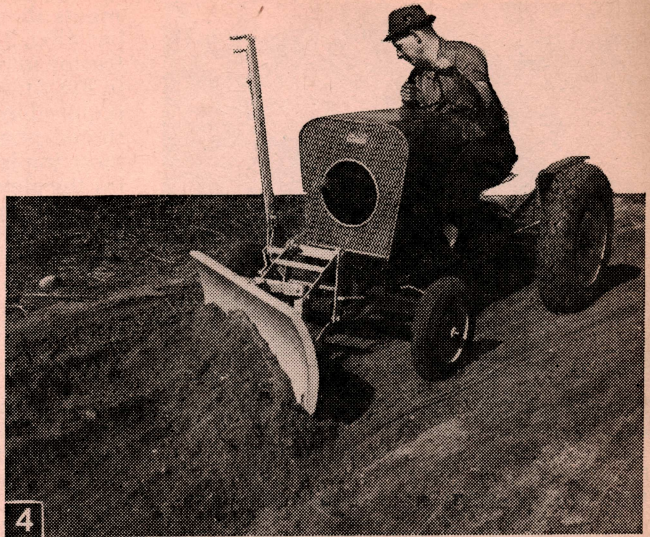




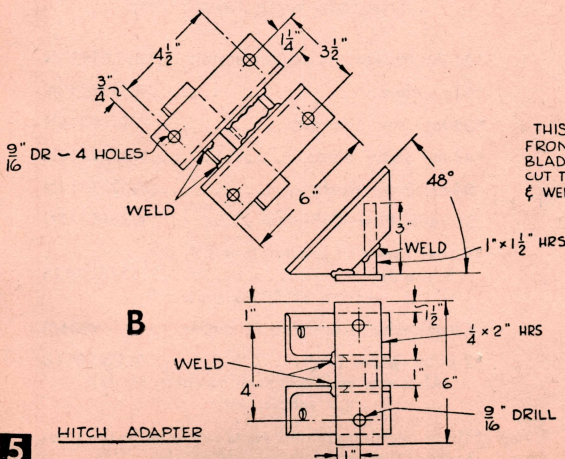
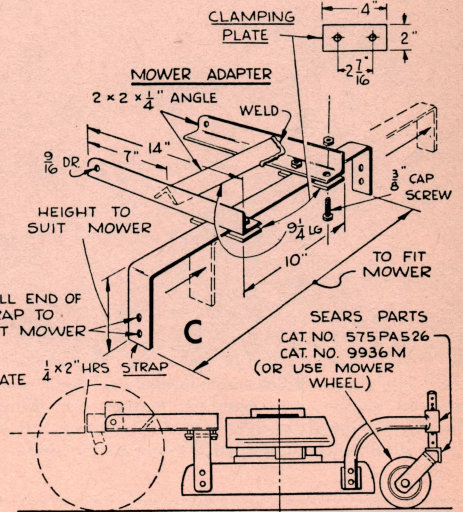
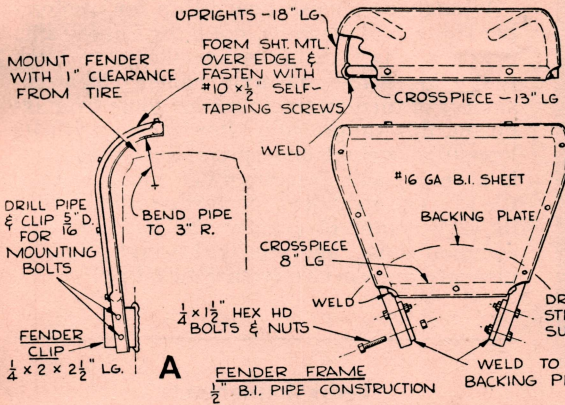
NEVER — HITCH LOAD TO AXLE HOUSING



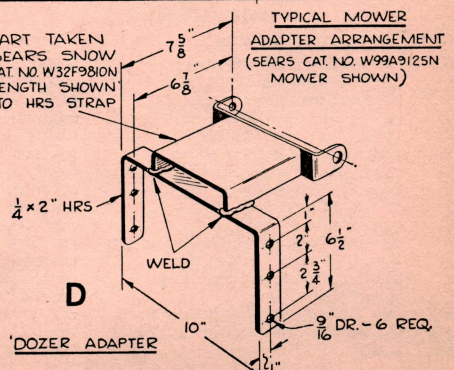
3 ALWAYS — HITCH LOAD BELOW AXLE TO TOW BAR



Grading is another heavy job Pow'r Pup revels in. Shown is the Sears snow blade, used here for smoothing off recent earth fill. When winter comes, Pow'r Pup really comes into its own, taking all the strain out of that winter back breaker, snow removal.

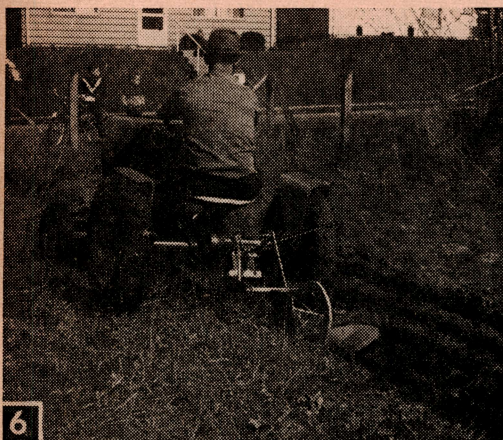


THIS PART TAKEN FROM SEARS SNOW BLADE CAT. NO. W32F9810N CUT TO LENGTH SHOWN & WELD TO HRS STRAP



5 HITCH ADAPTER

'DOZER ADAPTER



6 Small-scale farming is well within the scope of Pow'r Pup. You can plow over an acre a day, and disk it too, doing a first-class job of seedbed preparation.



7 Thorough disking breaks up the clods so small root-lets can get a start. Note the straightened lifting handle. Pulling it forward lifts the implement (plow or disk) when turning at the end of the row.

MATERIALS LIST

No. Req.	Description	Use
4	1/2" black iron pipe 18" long	fenders
2	1/2" black iron pipe 13" long	fenders
2	1/2" black iron pipe 8" long	fenders
4	1/4 x 2" HRS 2 1/2" long	fender clips
2	16 ga. black iron 15 x 15"	fenders
24	#10 x 1/2" self tapping screws	fenders
8	1/4 x 1 1/2" hex head bolts and nuts	fenders
2	2 x 2 x 1/4" angle iron 6" long	rear hitch
1	1/4 x 2" HRS 6" long	rear hitch
1	1/2 x 1" HRS 3" long	rear hitch
2	1/2 x 1 1/4" long hex head bolts and nuts	rear hitch
2	2 x 2 x 1/4" angle iron 14" long	mower adapter
1	2 x 2 x 1/4" angle iron 9 1/4" long	mower adapter
2	1/4 x 2" HRS 6" long	mower adapter
4	3/8 x 1 1/4" long hex head bolts and nuts	mower adapter
2	1/2" hex head bolts and nuts 1 1/2" long	mower adapter
1	1/4 x 2" HRS 30" long	'dozer adapter

ments should be hitched to the tractor tow bar (Fig. 3). If you wish to use Sears garden tractor implements, make the adapter shown in Fig. 5B, which provides the sloping surface required by the Sears implement hitch. Mount the adapter on the center of the tow bar for most implements, but toward the right side for the plow, so the right wheels of the tractor will run in the *old* furrow, while the plow-share cuts a new furrow and throws the dirt directly behind the right wheel (Fig. 6).

It will be necessary to straighten the handle of the Sears implement hitch so it will miss the right fender when the handle is swung forward. Do this with a welding torch, or simply cut off the bent part with a hacksaw.

To use the Sears bulldozer with Pow'r Pup, make the adapter (Fig. 5D) using a piece of the Sears 'dozer hitch with a welded-on strap. Bolt this to the implement clips on the tractor front axle. Bend the 'dozer operating handle to the right to clear the tractor hood (Fig. 4).

For a Decorative Finishing Touch, add the Pow'r Pup emblem to the sides of the hood, following the 2-in.-sq. layout in Fig. 2. Reverse the design (except for the name) on the left side of the hood so the Pup will be pulling forward.

Whatever you use Pow'r Pup for, remember it is a real machine, not a toy. Study Fig. 3 to see why it is necessary *always* to hitch pull-loads *below* the axle center. Most instances of turning tractors over come from ignoring this simple rule. Pow'r Pup, with its low-slung weight and spread-out wheelbase, is a very stable tractor, much more so than the average straddle-type garden tractor with its high center of gravity. So use care and common sense, and you will derive years of pleasure and service from Pow'r Pup.

Sears Implements

Useable with Pow'r Pup

*24-in. Mower (or similar style) . . . W99A9125N

*6-in. Plow . . . W32F9812N

*30-in. Disc Harrow . . . W32F9813N

*42-in. Snow Blade . . . W32F9810N

34-in. Drag Harrow . . . W32F9814N

Straddle-Row Cultivator . . . W32F9817N

*Caster fork and bracket (one RH, one LH req'd) . . . 575PA526
— from 32F545IN mower —

Caster wheels and tire (2 req'd) . . . 9936M

*3-point plow hitch . . . W32F9811C
(Also, any pull-tool such as carts, seeders, rollers, etc.)

*These implements and parts are seen in the photographs accompanying this article.

TWIN-LENS SPOTLIGHTED

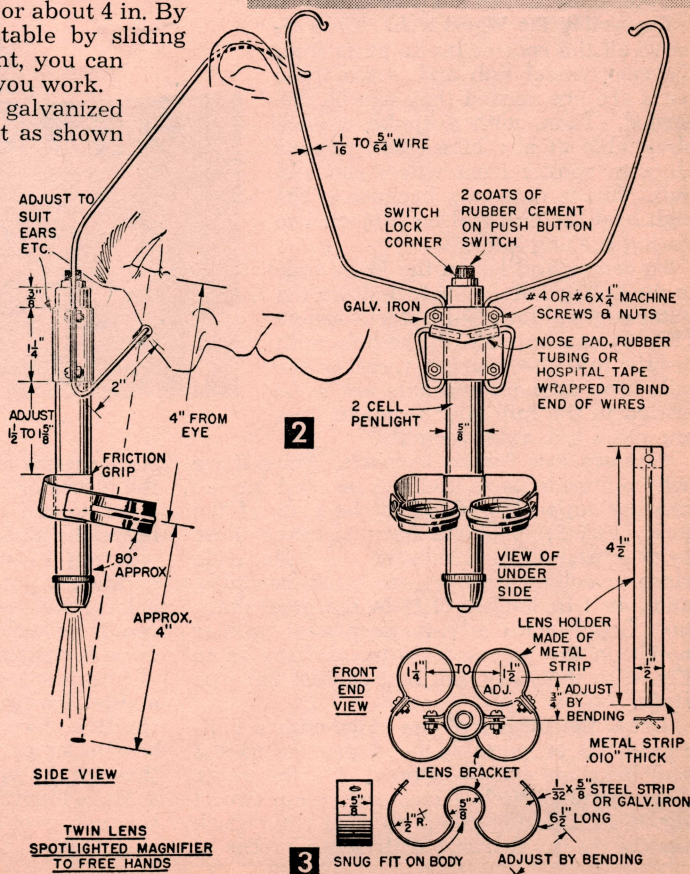
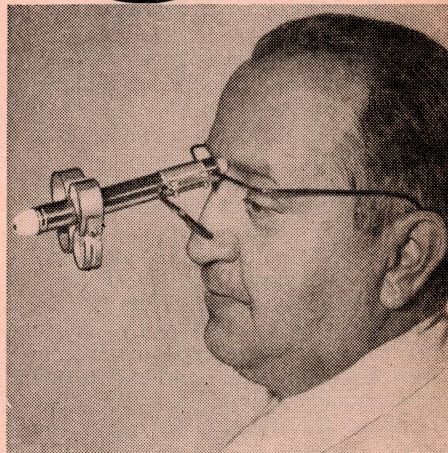
MAGNIFIER

FOR the close work that is a part of all model making, you'll like this latest and handiest combination of spotlight and twin magnifying lenses worn like spectacles. The spotlight focuses on the same point being magnified, leaving both hands free to work. In addition to holding the batteries and bulb, the pen-light case forms the structure for the magnifier and the track for adjusting the lenses. The light can be switched on by pressing the end button against the forehead.

Buy the pen-light from a variety store and be sure it is the type having two dry-cell batteries and a 3-volt lamp. Lenses are readily obtained (see Materials List). A 4-in. focal length will allow room for work under the lenses. Magnification will be $2\frac{1}{2}$ times. Higher powered lenses tend to have a focal length too short to permit working under them easily.

Whatever the focal length of the lens, the eye must be the same distance from the lens. With the lens specified this is 100mm or about 4 in. By making the lens holder adjustable by sliding along the barrel of the pen-light, you can get a true focus and keep it as you work.

Make the Lens Holder from galvanized or aluminum sheet and bend it as shown in Fig. 3. Bend the strips first into an angle, then bend them back by hand to leave a ridge around the center for holding the lenses in place. The edge of the lenses fits into these little grooves. Complete the circles and fasten them to the barrel of the penlight with #4 or #6 $\times \frac{3}{8}$ -in. machine screws. Bend up the bows that hold the unit in place from wire and adjust the nose-piece to fit.



MATERIALS LIST— TWIN-LENS MAGNIFIER

- | | |
|-----|---|
| No. | |
| 1 | 5" 2-cell "Penlight" flash light |
| 1 | galv. iron or aluminum strip, $\frac{1}{64}$ or $\frac{1}{32} \times \frac{1}{2} \times 12"$ |
| 2 | tin strips, about $.010 \times \frac{1}{2} \times 5"$ |
| 6 | #4 or #6 $\frac{3}{8}$ " machine screws |
| 3' | coat hanger wire |
| 6" | $1\frac{1}{2}$ " wide hospital tape or small diameter rubber tubing |
| 2 | 25mm. dia.— $2\frac{1}{2}$ -power 100mm magnifier lenses (Edmund Scientific Co., Barrington, N. J.) |

TWIN LENS
SPOTLIGHTED MAGNIFIER
TO FREE HANDS

3

SNUG FIT ON BODY ADJUST BY BENDING

Building and Riding a

Learning to ride this fugitive from the circus is becoming an increasingly popular modern day exercise

Coordination of mind and muscle, and balance are the skills you will develop as you train to become a successful unicyclist.

By HAROLD P. SMITH

A USED or even wrecked 20- or 24-inch bicycle will supply most of the major parts needed to make a unicycle, and you can build it for one-third the cost of a new one.

We chose 24-in. bikes for parts to build the unicycles shown in Fig. 1. If you are picking up a used or wrecked bike for parts, select one with a good front wheel fork and rear wheel. And, if possible, one having a New Departure Model D or Bendix 13 coaster brake because these types have rear wheel hubs that are identical in size and shape at both ends, a feature that simplifies the making of the axle adapters.

Converting the Wheel Hub. First remove all the coaster brake parts from the rear wheel hub and, since these parts are not needed they can be discarded. Then, with a spoke wrench obtainable at any bike shop, remove all wire spokes from wheel rim and hub. This is necessary because of the high heat the hub will be subjected to during brazing later.

To center and fasten the $\frac{5}{8}$ -in. axle to the hub, grind, file or turn down the outer edges of four $\frac{5}{8}$ -in. steel washers (Fig. 3) concentric with the hole to fit deeply into the bearing races of the hub. The washers and axle are to be brazed to the hub later to make up a one piece hub-axle assembly.

Fork and Axle Bearing Supports. Since there are no bicycle parts that can be used for the bearing supports welded to the ends of the fork (Fig. 2), you will have to make these from scratch. First hacksaw two $\frac{3}{16}$ -in. wide rings or collars from $1\frac{1}{2}$ -in. black-iron pipe, and four 1-in. lengths of $\frac{1}{2}$ -in. dia. steel shafting. Grind or file a $\frac{1}{16}$ -in. deep semi-circular notch on the pieces of $\frac{1}{2}$ -in. shafting as in Fig. 4, so that they will seat against the pipe rings.

Dress the insides of the rings with a half-round file or portable hand grinder so the ball bearings can be slipped into the rings. Then remove the bearings and clamp two of the $\frac{1}{2}$ -in. shafting pieces to each ring. Back up the $\frac{1}{2}$ -in. shafting with scrap pieces of



steel square stock as in Fig. 4, and be sure the pieces of $\frac{1}{2}$ -in. shafting are diametrically opposite and parallel to each other. Weld or braze the pieces of shafting to the rings.

If you are not equipped to do the welding or brazing yourself and must have it done at a local weld shop, make up all of the parts requiring welding so you can have all of it done at one time. It will be cheaper that way.

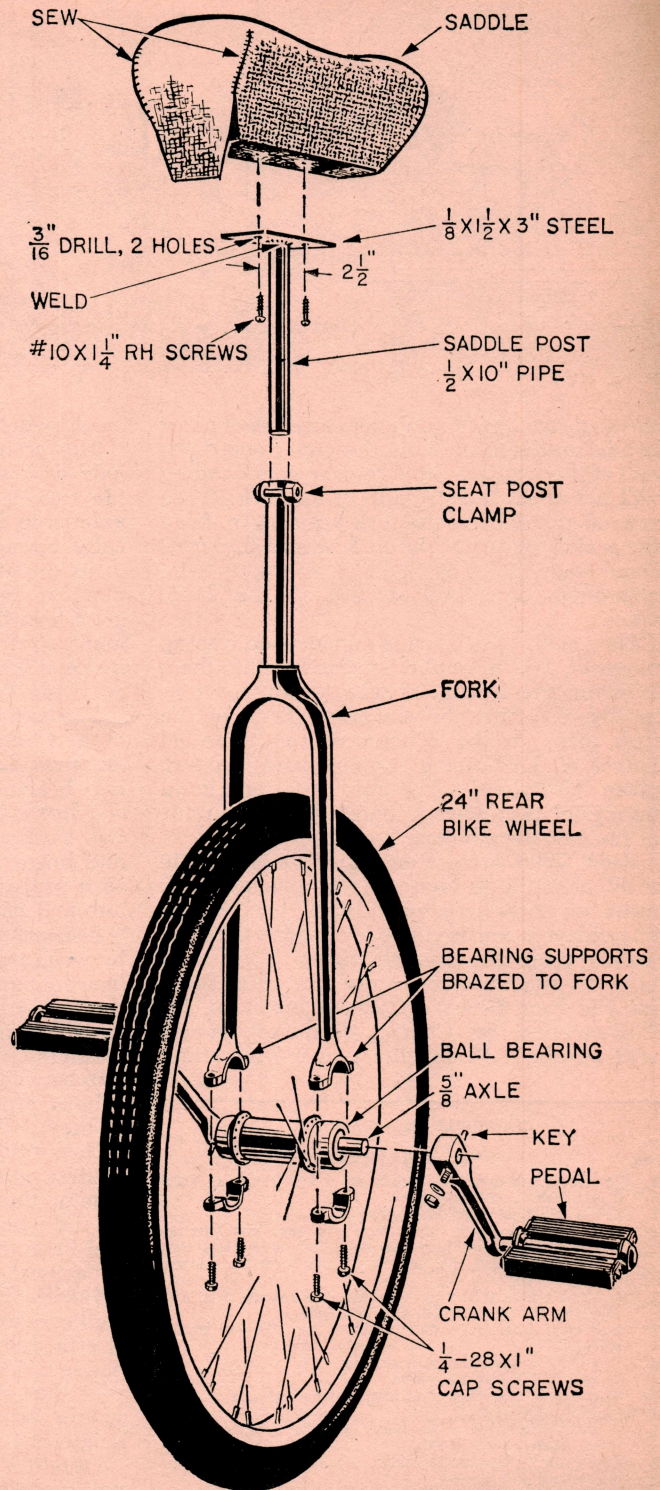
After the bearing supports are brazed, bore a hole through the center of each of the $\frac{1}{2}$ -in. shafting pieces with a #3 drill. Then saw the bearing supports apart with a hacksaw, cutting through the $\frac{1}{2}$ -in. pieces of shafting as in Fig. 4. Make identifying centerpunch marks on the two halves of one of $\frac{1}{2}$ -in. shafting pieces on each support so that they can be reassembled

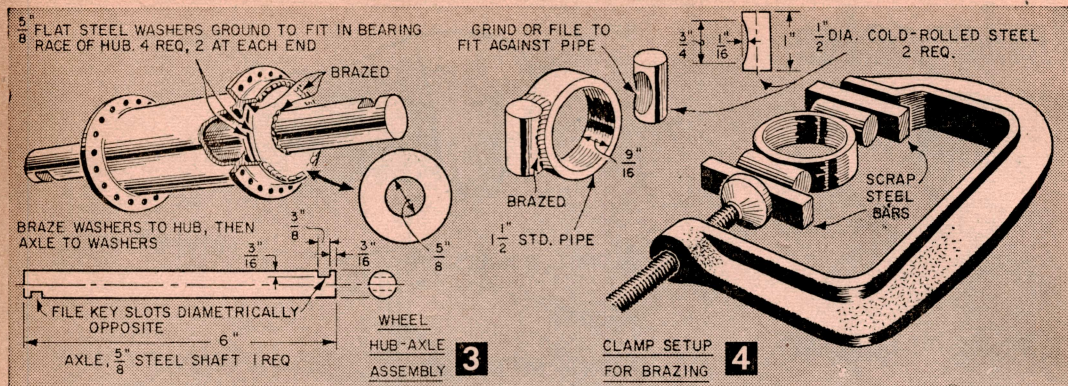
Unicycle



exactly as they were before cutting apart. Next, redrill or open the #3 drilled holes in one side of each bearing support with a $\frac{1}{64}$ -in. drill. Tap the #3 holes in the other sides with a $\frac{1}{4}$ -28-in. tap. Use $\frac{1}{4}$ -28 x 1-in. hex-head cap screws to fasten bearing support halves together.

Since all bicycle forks are bent slightly for caster effect, your first job will be to straighten it. Clamp the fork between two soft-wood blocks in a vise and, with a length of 1 or $1\frac{1}{4}$ -in. pipe slipped over a fork arm for leverage as in Fig. 5, carefully bend


2
UNICYCLE ASSEMBLY



the arm straight. If you make a series of short bends, gradually moving the pipe toward the end of the fork arm, this reverse cold bending will not affect the strength of the fork. Then saw off the ends of the fork arms 12 in. from the inside center of the fork where the arms come together. This will leave about $\frac{1}{2}$ -in. clearance for a balloon tire on the 24-in. wheel.

Now clamp the bearing supports on a scrap piece of $1\frac{5}{8}$ -in. round stock, spacing them 3 in. or the length of wheel hub apart as in Fig. 6. Butt the sawed-off ends of the fork arms to the centers of the threaded halves of the bearing supports and braze in place. Use plenty of brazing metal and build up a joint that flows smoothly to the contour of the bearing support.

Pedal Crank Arms. Since it would take quite a bit of work to adapt the one-piece crank arms on American-built bikes for use on this unicycle, we used two lefthand cranks and pedals made for English bikes. Your local bike shop or hardware store can order these for you from Chicago Cycle Supply Co., 224 N. Desplaines St., Chicago, Illinois. The cost will be about \$6 for the two $5\frac{1}{2}$ -in. crank

arms, pedals and fastening keys.

The crank arms fasten to the $\frac{5}{8}$ -in. hub axle with tapered keys, so you will have to file two $\frac{3}{8}$ -in. key slots at the ends of the axle as in Fig. 3. Make these slots diametrically opposite each other. Have the crank arms on hand when filing the slots so that you can make trial assemblies to obtain a good firm fit with no play. Any loose movement of the crank arms on the axle would make it very difficult to ride the unicycle, particularly for a beginner.

The axle can now be permanently brazed to the wheel hub. Place one of the four washers, previously ground down to fit within the hub bearing races, into each end of the hub and braze in place. Then position the other two washers flush with the ends of the hub and braze. Finally, insert the axle, position so it projects equi-distant at each end of the hub and braze it to the end washers.

Reassembling the Wheel. Clamp the fork between two pieces of wood in a vise with the bearing supports up. Hang the wheel rim in the fork crotch and install the hub assembly with bearings in the bearing supports. If washers or spacers are needed to center the hub between the bearings, saw two rings from a $\frac{1}{2}$ -in. pipe and dress the insides with a file so they will slide on the $\frac{5}{8}$ -in. axle shaft.

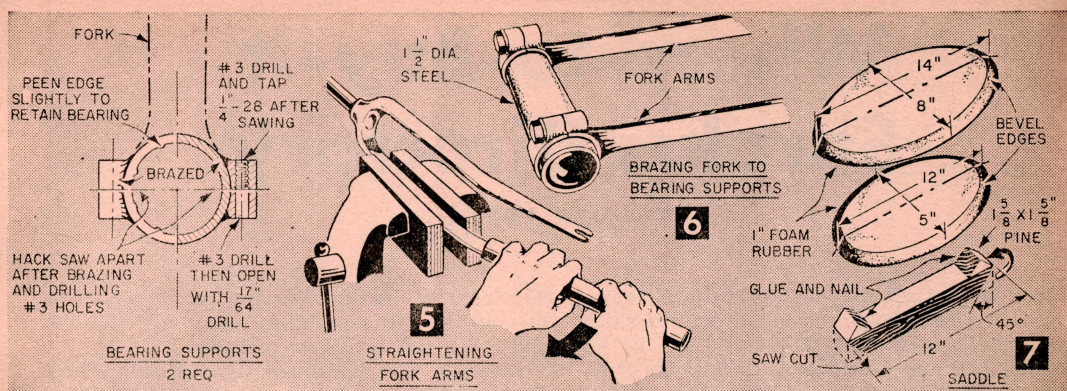
Now, replace the wire wheel spokes, loosely at first, and gradually tighten them as you true up the wheel. If you have trouble truing up the wheel, take it to your local bike shop and have it done because this is a job where experience can save a lot of time.

Saddle. Regular bike seats don't work too well on a unicycle. Most riders prefer a deeply crotched saddle about 4-in. wide and softly padded. The saddle is mounted on a metal post that slides inside the fork stem so the saddle height can be adjusted to suit the length of the rider's legs.

Obtain a 10-in. length of pipe or tube that will just slide into the stem on the bike fork you used, and weld a piece of flat steel to one end as in Fig. 2. Drill two $\frac{3}{16}$ -in. holes in it for fastening to the saddle later. To clamp the

MATERIALS LIST—UNICYCLE

No. Req.	Size and Description
1	24" bicycle rear wheel and tire having a New Departure Model D or Bendix 13 coaster brake
1	24" or 26" front wheel bicycle fork
2	$5\frac{1}{2}$ " left-hand pedals, crank arm and keys made for an English bicycle (Your local bike dealer can order these from Chicago Cycle Supply Co., 224 North Desplaines St., Chicago 6, Ill.)
2	$\frac{5}{8}$ " bore x $1\frac{5}{8}$ " O.D. x $\frac{1}{2}$ " wide Nice ball bearings #3028DS (available from local Boston Gear distributor)
2	$\frac{3}{16}$ " rings from $\frac{1}{2}$ " standard black-iron pipe for bearing supports
4	$\frac{1}{2}$ x $1\frac{1}{2}$ " long cold-rolled steel shafting
4	$\frac{1}{4}$ -28 x 1" hex-head cap screws
1	$\frac{5}{8}$ x 6" long cold-rolled steel shafting for wheel axle
4	$\frac{5}{8}$ " flat steel washers
1	$\frac{1}{2}$ x 12" long standard black-iron pipe for saddle post and spacer washers for $\frac{5}{8}$ " axle
1	$\frac{1}{8}$ x $1\frac{1}{2}$ x 3" flat steel for saddle post
1	bicycle seat-post clamp
2	#10 x $1\frac{1}{4}$ " rh wood screws
1	$1\frac{3}{8}$ x $1\frac{3}{8}$ x 12" pine for saddle frame
1	1 x 18 x 18" sponge or foam rubber
1	10 x 24" upholstery fabric



saddle post at any height on the fork stem, hacksaw a 1-in. long slot at the end of the stem and over this, place a bike seat-post clamp. You may have to spread the post clamp a little to make it fit.

For the saddle, cut the ends of a 12-in. length of 2 x 2-in. pine at a 45° angle and fasten the two cut-off pieces to the 12-in. piece with glue and nails as in Fig. 7. File and sand all of the corners and edges round and give it two coats of shellac. Then cut two oval-shaped pieces of 1-in. thick sponge or foam rubber as in Fig. 7, and bevel the edges. Stretch the small oval of sponge rubber across the triangular blocks on the wooden frame and fasten to ends of the 12-in. piece with rubber cement and a few roofing nails. Center the large oval-shaped piece of sponge rubber over the smaller one and fasten all around with rubber cement.

Next, cover the rubber padding with upholstery fabric, overlapping and tacking the long edges to bottom of the wooden frame first. Then fold and tuck the material at the corners under the ends and tack the ends to the bottom. Stitch the folded corners to the sides with heavy thread. Center and fasten the saddle post to the bottom of the padded saddle with two #10 x 1¼-in. rh screws.

When assembling the saddle to the fork, adjust the height of the saddle so that the distance from the top of the saddle to the pedal nearest the floor is equal to the rider's full leg length as measured from the crotch to the foot instep.

How to Ride a Unicycle. According to Mr. Joseph J. Giallombardo, a veteran unicyclist and physical education instructor at New Trier High School, Winnetka, Illinois, the best way of becoming accustomed to the "feel" of being on the unicycle and to practice balance, is to hold on to a gymnasium stall bar with one hand as you rock the wheel back and forth slightly with the foot pedals. Outdoors, you could hang on to a fence or clothesline post to maintain side-to-side or lateral balance. Have the pedal crank arms in the horizontal position so the wheel can

be rocked easily and instantly to maintain fore and aft balance. Place the balls of your foot, not instep, on the pedal.

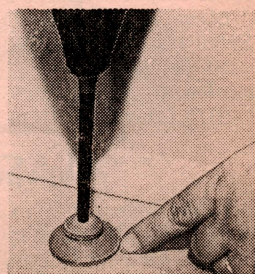
The whole trick is in being able to quickly shift the wheel hub directly under the center of gravity of you the rider. Do not attempt to remain motionless. You must keep rocking the wheel back and forth to maintain balance.

To get off the unicycle gracefully, move your body weight just a little ahead of the wheel axle. Then, as one pedal nears its lowest position, step forward and down, reaching back with your hand to catch the unicycle by its saddle.

To mount the unicycle, without the aid of a fence or post, stand in back of the cycle straddling the saddle. Have the left pedal near the floor and place your left foot on it lightly. Bend forward and grasp the tire with your right hand a few inches forward of the fork. Now, using the left pedal as a step, push yourself forward and quickly place your right foot on the right pedal while moving the wheel first back and forward with your hand to keep your balance. When the crank arms reach the horizontal position, straighten up and hold your arms outspread at your sides to help maintain lateral balance. Then lunge forward, making one complete turn of the wheel, so your feet again return to the horizontal position where you can rock the wheel to regain your balance. With continued practice, you will soon find that you can make several complete turns of the wheel before rocking to regain balance.

Suction Cup Umbrella Stand

• Keep your umbrella standing upright on a tiled office foyer or other slippery floor by fitting a small suction cup to the tip.—R. F. DONAVAN.



Where-to-Buy-It Surplus Directory

(Revised 1962)

More than 1000 surplus dealers are represented in this newly revised directory which lists firms located in all 50 states, the District of Columbia, and Canada. All are in the business of handling government and industrial over-supply and/or used equipment, but in widely varying degrees.

Many of these suppliers handle a wide variety of items at all times. Others specialize in just a few related lines. Still others are primarily merchandisers of newly manufactured goods

who usually, but not always, carry a surplus line or two. Dealers who offer only clothing and other soft goods are not listed.

Listings are arranged alphabetically, first under state headings, then town or city. Numbers appearing at the end of a listing indicate particular lines of surplus usually carried. To identify these numbers, refer to the key of classifications on the adjoining page. An explanation of the abbreviations used appears immediately below.

KEY TO ABBREVIATIONS:

Cat.—Catalog or price list published
W—Wholesale **R**—Retail **W&R**—Both
Min. (plus price)—Smallest cash order
Min. (plus %)—Smallest deposit on C.O.D.
Number in parentheses—Postal zone

ALABAMA

Birmingham—Army Surplus Store, 2400 1st Ave. N.—11, 22.
Cullman—Salvage, Inc., 108 E. 4th St.
Decatur—Denbo Iron & Metal Co.—30.
Gadsden—Alabama Salvage & Furniture Co., 106 S. 26th St.
Mobile—Gulf Machinery Co., Box 6013, Loop Sta.
Herman's Army & Navy Store, 454 Dauphin St.—11.
Johnson Motors, 158 N. Royal.
Marine Junk Co. Inc., 158 S. Water St.—8, 24, 29.
Mobile Salvage Co., 64 S. Commerce.
Montgomery—Bonfield's Clothing & Paint Store, 31 Monroe—11.
Sabel (M.) & Sons, 749 N. Court—14, 16, 17, 24, 33, 40.
Tuscaloosa—Army Store, 621 24th Ave., Box 9115 (Harold L. Bank)—11.

ALASKA

Fairbanks—Honest John Breman, Box 769.
Mount View—B & J Surplus Stores, Box 861.
Seward—Andrew Army Store.

ARIZONA

Flagstaff—Salvage Stores, Inc., 2008 N. 3rd E.
Glendale—Pacific Surplus Stores, 932 E. Glendale Ave.
Phoenix—Maricopa Iron-Metal, 4202 E. Windsor (6)—30.
Tri-State Machinery Co., 2840 E. Washington (David Caplan)—44.
Valley Distributing Co., 2121 N. 23rd Ave., R.
Tucson—Speedway Tools & Supply Co., 5846 E. Speedway—40.

ARKANSAS

Fort Smith—Tucker Duck & Rubber Co., 515 Garrison St.
Hackett—Quonset Trading Post.
Hot Springs—Hobson Motor Co., 900 Hobson.
Little Rock—Bennett's Military Supplies, 222 Main—11.
Goldman & Co., 400 E. 2nd—11.
Newport—United Salvage Store, Box 175.

CALIFORNIA

Bakersfield—Floyd's Surplus, Inc., 18834 S. Chester—11.

KEY TO DIRECTORY CLASSIFICATIONS

Type of Surplus	No.	Type of Surplus	No.
Aircraft, Components and Supplies.....	1	Hardware Items.....	24
Aircraft Engines and Parts.....	2	Hydraulic Parts.....	25
Automotive Engines and Parts.....	3	Lighting Plants, Equipment.....	26
Aviation Cockpit Instruments.....	4	Magnets.....	27
Batteries.....	5	Marine Accessories.....	28
Bearings, Bushings.....	6	Marine Engines and Parts.....	29
Blowers, Fans.....	7	Metals (Iron, Steel, Aluminum, etc.).....	30
Boats, Hulls.....	8	Meters, Lab Instruments.....	31
Cabinets, Chassis, Panel Cases.....	9	Nuts, Bolts, Screws, Washers, etc.....	32
Cameras.....	10	Optics.....	33
Camping and Sporting Goods.....	11	Plastics (Sheet, Rod, Tube).....	34
Chain Hoists.....	12	Plumbing Equipment, Pipe, etc.....	35
Chemicals.....	13	Radio Transmitters, Receivers.....	36
Compressors, Pumps.....	14	Rope (Manila, Synthetic).....	37
Electrical Equipment and Supplies.....	15	Solenoids.....	38
Electric Motors and Parts.....	16	Tires.....	39
Electronic Parts.....	17	Tools (Hand, Power).....	40
Electronic Tubes.....	18	Tractor Parts.....	41
Electric Wire and Cable.....	19	Transformers.....	42
Fire Extinguishers.....	20	Transistors, Diodes.....	43
Firearms.....	21	Trucks, Heavy Equipment and Parts.....	44
Foam Rubber.....	22	Wire, Wire Rope, Cable, Chains.....	45
Generators.....	23	General Surplus.....	No Number

California

Bell—Bell Surplus Co., 4476 E. Gage, R.
 Bellflower—Doughboys of Bellflower, 9812 E. Artesia, R.
 Sad Sack Stores, Inc., 15220 Lakewood Blvd., R.
 Belvedere—Kerson (George) Co., Box 588, W.
 Berkeley—Eagle Electronics, 2353 San Pablo Ave.—15, 17, 36.
 Beverly Hills—Carter (Stanford I.), 360 N. Bedford Dr., W.
 Goldman (Robert), 160 N. Stanley Dr., W.
 Buena Park—Cook's Surplus Merchandise, 6001 Beach Blvd., R.
 Burbank—Burbank Surplus, 411 N. San Fernando Rd., R.
 Mort's Surplus Mart, 419 N. Victory Blvd. (Mortimer Schlanger), R, 25% dep. on COD —6, 17, 24, 40.
 Surplus Emporium, 503 N. Victory Blvd., R.
 United Merchandise Corp., 510 N. Victory Blvd., R.
 Compton—Equipment Repair Parts, Inc., 2929 N. Santa Fe Ave. (2) R, 25% dep. on COD —41.
 Costa Mesa—Grant's Surplus, 1750 Newport, R.
 Culver City—Airborne Sales Co., Inc., 8501 Stel-

lar Dr., Box 2727—1, 2, 4, 7, 14, 15, 16, 19, 23, 25, 26, 27, 28, 29, 31, 33, 38, 40, 42, 45.
 Retting (Martin B.), Inc., 11029 Washington (12)—21.
 Daly City—Zuckerman (Henry), 192 Moltke St., W.
 Eureka—Government Surplus Sales, 226 F St., R.
 U. S. Surplus Outlet, 3935 Sepulveda Blvd., R.
 Fresno—Fresno Salvage Co., 6291 Blackstone.
 War Surplus Depot, 602 Broadway—11.
 Gardena—Barnacle Bill, 853 W. Gardena Blvd., R.
 Ellis Co. (The), Box 229, 15601 S. Broadway —39, 41, 44.
 Gilroy—Gilroy's Surplus, 248 N. Monterey, R.
 Glendale—Ames Harris Neville Co., 1255 Flower St., W.
 Valley Accessories, 6325 San Fernando Rd., R.
 Harbor City—Western Aircraft Parts, 26003 S. Normandie—2.
 Highland Park—Highland Park Surplus, 5917 N. Figueroa, R.
 Hollywood—Hollywood Surplus, 6250 Hollywood Blvd., R.

California

- I. & L. Surplus, 6263 Santa Monica Blvd., R.
Indio—Indio Mercantile Co., 44-859 Towne St., R.
Inglewood—Inglewood Surplus Co., 839 S. La Brea, R.
La Mirada—Oxman Enterprises, Box 55, R, 50% dep. on COD—14, 16, 25, 45.
Lawndale—Dryer (Charles), 4137 W. 159th St., W.
Long Beach—A-1 Salvage Co., 3031 Long Beach Blvd.
 Catalina Sporting Goods, 6500 Long Beach Blvd.—11.
 Long Beach Surplus, 3515 Long Beach Blvd., R.
 Murphy Surplus Store, 1086 Obispo.
Los Angeles—A. & M. Surplus, Inc., 952 S. Broadway, R.
 ABC Salvage Co., 4080 Whittier St.
 Acme Salvage Co., 3370 E. Florence Heights Park.
 Airmotive Equipment of California, 10655 Alameda.
 Al's Surplus, 3771 Lackland Dr., R.
 All American Sport Goods, 383 N. Western Ave., R—11.
 Allender (Irving) Co., 1608 W. Pico Blvd. (15)—22, 34.
 American Canvas Co., 712 S. Santa Fe, W—11.
 Angelus Surplus & Supply Co., 5890 W. Adams Blvd., R.
 Arco Sales, 10803 Avalon Blvd., R—11, 24.
 Barnett Surplus Co., 5984 W. Pico Blvd. (35), (S. Barnett), W&R—26, 43.
 Barton (S. H.), 4910 S. Vermont Ave., W.
 Bell Sales, 4401 S. Vermont, R.
 Blazer (Dave E.), 2215 N. Broadway (31), W&R—11.
 Broadway Surplus, 3072 W. Pico Blvd. (16), W—11.
 Cash Sales Store, 1288 S. La Brea, R.
 Coast Surplus Stores, 5817 N. Figueroa (42).
 Cohen (Edwin), 1560 N. Laurel, W.
 Cohn & Shane, Inc., 1323 Venice Blvd. (6), W—11, 40.
 Desser Tire & Rubber Co., 6208 S. Alameda St.—39.
 El Paso Pipe-Machinery Co., 722 E. 14th St.
 Empire Sales Agency, 10970 Main St.
 Federal Sales, 3128 S. Vermont Ave. (7), R.
 Firestone Surplus, 1462 Firestone Blvd., R.
 Friedman (Jack L.), 512 S. Hobart Blvd., W.
 Gene's Surplus, 1226 E. 7th St., R.
 Gold (Harry), 1007 E. Olympic Blvd. (21), W.
 Grossman (Max), 1569 S. Stanley Ave. (19), W.
 Harry's Surplus, 12512 W. Washington Blvd., R.
 Howard Sales & Supplies, 1401 S. Alameda St. (21), R—11.
 Howard Sales & Surplus Co., 1401 Salameda.
 Kigel Textile Co., 3117 W. 8th St. (5)—11.
 Leo's Surplus, 8901 S. Broadway, R.
 Leonard's Surplus Mart, Inc., 1660 S. La Cienega Blvd., R.
 Los Angeles Surplus, 11269 Santa Monica Blvd., R.
 Mar Vista Surplus, 12306 Venice Blvd. (66), R.
 Marmor Sales Co., 4377 S. Figueroa, R.
 Mars Sales Co., 9033 W. 24th St., W.
 Meyer (Jack), 2269 N. Beachwood Blvd. (28), W, Min. 50%—6, 16, 23, 24, 27, 32, 34, 40, 45.
 Michaelson (D. S.), 700 Exposition Blvd., R.
 Mifran-Bowman Co., 8015 South Alameda Street, W.
 Newman (The) Co., 3057 W. Pico Blvd., W.
 Palley Supply Co., 2263 E. Vernon Ave. (58), (William D. Palley), Cat., W&R, Min. \$1—1, 6, 7, 12, 14, 16, 17, 23, 25, 27, 32, 38, 42, 45.
 Panamco Sales, 1632 Stearns Dr., W.
 Rex Wholesale Co., 10615 Exposition Blvd., W.
 Rose (George) Co., 1225 S. Grand Ave. (15)—21, 36.
 Rubin (Harry), 3945 Stevely Ave., W.
 Shirek (R. A.), 2441 Hunter St. (21), W.
 Siegel (J. M. and Morton), 465 E. 3rd St., (13), W.
 Standard Surplus Sales, 534 S. Towne (13), (Frank Leipzig), W.
 Sun Coast Merchandise Corp., 1340 S. Hill St. (15), W—10, 33.
 Sway & Sway, 2601 Pasadena Ave., W.
 Terminal Surplus, 3055 Crenshaw, R.
 Topp Sales Co., 2456 W. Washington Blvd., W.
 U. S. Trading Co., 4429 S. Central Ave., W.
 United Supply Co., 3675 S. Main St., R.
 Value Center, 3828 Sunset Blvd.
 Victory Salvage Co., 8211 S. Alameda (1), W—12, 23, 24, 25, 28, 40, 45.
 Volume Sales Co., 441 S. San Pedro St., (13), W.
 Werner (Siegmond) Co., Inc., 302 N. Ave. 21—11, 28.
 Western Carloading Co., 960 E. 3rd St., W.
Manhattan Beach—Manhattan Surplus Center, 2401 Sepulveda Blvd., R.
Marysville—General Sales Co., 316 2nd St., R.
Maywood—United Surplus, 4501 E. Slauson, R.
Merced—Kellogg's Supply Co., Box 211, 2255 E. Yosemite Pkwy., R.
Modesto—Crescent Supply Co., 813 8th St., R.
Monterey Park—Hittleman (Miles), 1045 Ridge Crest, R.
Morro Bay—Horton's, Box 635, R.
Napa—Brewster's, 1146 Main St., R.
North Hollywood—Norton Sales Co., 7052 Laurel Canyon.
North Sacramento—Capitol Surplus, 3008 Rio

California

- Linda Blvd. (15), (N. J. Clark), W&R, Min.
50%—6, 11, 23, 24, 25, 32, 34, 40.
- Federal Iron & Metal Co., 2445 Manning—30.
- Oakland**—Acme Surplus, 533 8th St.
General Surplus Sales, Bldg., 725, Oakland
Airport—17, 24, 36.
Hogan's Surplus Stores, 3540 Broadway, R.
Hub (The), 469 13th St.
Schuman Sales Co., 2349 San Pablo Ave.
(Manny Schuman), W.
United Surplus Sales, 198 11th St., R.—11,
22, 28.
Zimm & Sons, 3115 Adeline St., W.
- Ontario**—Miller's Surplus, 106 Euclid, R.—11,
22, 23, 24, 33, 40.
- Orange**—Robinson Electronics, 922 W. Chap-
man—17.
- Pasadena**—Bradley's, 99 E. Colorado Blvd., R.
C. and H. Sales Co., 2176 E. Colorado Blvd.
(8), (Carl E. Izbicki), Cat., W&R, No Min.
—1, 2, 4, 5, 6, 7, 16, 17, 18, 19, 23, 25, 27, 31,
34, 36, 38, 40, 42.
- Paramount**—Golden Crown Paint Co., 8316 E.
Gardendale, W.
- Petaluma**—Friedman Bros., 17 E. Washington,
R.
Sarro's Surplus, 7 Main St., R.—11.
- Pismo Beach**—Paul's Surplus, 921 Price St., R.
- Redwood City**—Bay Bridge Sales Co., 2001 Bay-
shore Blvd.
Redwood Surplus, Inc., 1629 Main St., R.
- Reseda**—Beckman, (David), 6900 Bertrand, W.
- Richmond**—A&B Surplus Sales, 419 Macdonald
Ave., R—11, 40.
- Rocklin**—Eddo Surplus Sales, Box 657, (Don
Otis), W&R—1, 2, 4, 7, 14, 23, 24, 25, 26,
30, 32, 45.
- Sacramento**—Berman (Ted) Co., 4920 Franklin
Blvd., R.
Metropolitan Surplus, 510 K St., R.
Sacramento Surplus Sales, 4801 Hedge Ave.,
R—24, 40.
Selectronics Electronics Surplus, 4113 Frank-
lin Blvd.—17.
Stice (Cliff) Tire Supply, 534 Broadway—45.
- San Bernardino**—Associated Wholesale Co., 708
N. Waterman, R.
Highway Center, 24053 Highway 99, R.
War Surplus Outlet, 7th & Waterman—15,
22, 24, 35, 36, 40.
- San Diego**—Allied Electronics, 4081 University
—17.
Equipment Brokers, Inc., 4206 Fairmont.
George's Surplus & Salvage, 3354 Market St.
Western Salvage Co., 1461 Market St.
- San Francisco**—American Sales Co., 684 Mc-
Callister St., W.
American Salvage Co., 33 Filbert.
Cleveland Wrecking Co., 2800 3rd St.
Consolidated Iron & Metal Co., 634 Townsend
—30.
- Davis (Joseph N.), 1665 Chestnut St., W.
Electro Mechanical Sales, 231 Valencia—15,
16, 17, 24.
G. & M. Sales, 1667 Market St., R.
Kaplan's Salvage, 1499 Market St.—11, 22,
40.
Land Brothers, 581 Market St.
Lorber's Surplus Store, 1024 Mission St.—11,
22, 24, 33, 40.
Rubino Sales Co., 707 McAllister, W.
Service Sales & Electrical, 167 Day St., W—
15, 16.
Standard Surplus, 1230 Market St.—17, 24,
40, 42.
Sumner & Co., 2435 Mission St., R.
Sun Tent-Luebbert Co., 355 Brannan St. (7),
W.—11.
U. S. Industrial Sales, Inc., 532 6th St. (3),
(Louis Laub), Cat., W&R—7, 14, 17, 18, 19,
23, 24, 27, 31, 40, 42, 43.
- San Jose**—Cottons (Mel), 1266 W. San Carlos,
R.
Levin Salvage Co., 1930 1st St.
Red Front Surplus, 434 S. 1st St., R.
- San Leandro**—Kaplan Sporting Surplus Sales,
555 E. 14th—8, 11, 22, 40.
- San Pablo**—Bob's Surplus, 14012 San Pablo
Ave.—11, 22, 24.
Immel (Lee J.), 13555 San Pablo Ave.—14,
29, 44.
- San Pedro**—Norman's, 371 W. 6th St., R.
- San Rafael**—Capel (Friedman) Co., 933 Fran-
cisco Blvd., R.
- Santa Barbara**—Dunnall's, 605 State St., R.
- Santa Maria**—Freitas Merchandise Co., 213 S.
Oakley, R.
- Santa Monica**—Frost (Jack D.), Co., 11020 W.
Pico Blvd., R.
Korey's War Surplus, 1302 Santa Monica, R.
Quonset Hut, 829 Broadway, R.
Sandy's Surplus, 804 Santa Monica Blvd., R.
- San Gabriel**—Doughboys of Garvey, 8344 E.
Garvey, R.
- Stockton**—Dervin (Val) Stockton Surplus De-
pot, 7 W. Weber Ave.
Herb's Surplus, 820 E. Main St., R.
- Sunland**—Zwern Bros., 8119 Foothill Blvd., R.
- Tulare**—Airplane Tire Co., Div. of Ben W. Col-
burn Co., 520 S. K St.—39.
- Turlock**—Turlock Sales, Box 1005, R.
- Van Nuys**—Art's Surplus, 6212 Sepulveda Blvd.,
R.
Ben's Surplus Co., 6156 Sepulveda Blvd., R.
Brown & Co., 14715 Marlin Pl., W.
Kriegler (Joe), 6869 Varna, W.
- Ventura**—Korbs Trading Post, 6587 Ventura
Blvd., R.
Phillips-Hollywood, 484 S. Main St., R.
- Visalia**—Army Surplus Sales, Box 5, R.
- Walnut Creek**—Surplus Mart, 1330 North Main
Street.

California

Windsor—Windsor Surplus, 375 River Road—11, 22, 35, 40.

Woodland—Woodland Mercantile Co., 407 Main St., R.

COLORADO

Colorado Springs—Champion Sales Co., 1938 Armstrong Ave.

Denver—Army & Factory Surplus Distributors, 2300 Walnut—11, 40.

Aurora Salvage Co., 1556 Florence.

Epcar Surplus Div., 4401 Wynkoop (Geo. Epcar)—44.

Green & White Surplus Stores, 1455 S. Lipan (23)—11, 24.

Joseph (Leonard) Co., 1800 Stout St.—11.

Star Surplus Stores, 816 Federal Blvd.—11, 24, 40.

Surplus Super Mart, 5501 Federal Blvd.—3, 11, 15, 17, 24, 33, 40.

Surplus Tool & Commodities, 1411 W. Alameda Ave.—11, 24, 33, 36, 40.

Fort Collins—Jax Surplus & Salvage Co., 1200 N. College Ave.

Greeley—H. & P. Army Surplus, 821 9th St.

Pueblo—Brown's Sporting Goods, 603 N. Santa Fe.

CONNECTICUT

Branford—Branford Automotive Supply Co., 37 Main St. (Raymond N. DeAngelo)—3.

Bridgeport—Army & Navy Store, 990 Main St.—11.

Jacob Bros. Inc., 1240 Seaview Ave.—11, 40.

Danielson—Danielson Surplus, 98 Main St.

Fairfield—Heliparts, Inc., Box 131 (W. J. Roberts), W&R, Min. \$5—2.

Hartford—Criterion Co., 331 Church St.—33.

Katten & Son, Inc., 190 Farmington Ave. (5).

Manchester—General Sales Corp., 202 S. Main St.

Manchester Surplus Sales, 169 N. Main St.

New Britain—Aaron Salvage, 208 Arc St.

Hoffman's Army & Navy Store, 340 Main—11.

New Haven—Aircraft Radio Industries, Inc., 85 St. John St. (11), (Eli Jacobson)—2.

Central Army & Navy Store, 453 State St.

Newington—Thomson Surplus Stores, 2660 Berlin Tpke. (Bill Thomson)—11, 24.

Norwich—American Waste & Metal, 112 Summit St.—30.

Surplus Center, 114 Water St.—11, 24, 28.

Orange—Herman's Army & Navy Super-Mart, 212 Boston Post Rd.—11, 24, 28.

Surplus Trading Post, Inc., 153 Boston Post Rd.—11, 28, 40.

Southport—Fairfield Trading Post, 3310 Post Road—11.

Willimantic—Surplus Center, 789 Main St.—11, 24, 28.

DELAWARE

Dover—Levi (J.) & Co., 131 Lockerman St.

Milford—Haber's Mart of Milford, Front and Walnut Sts.

Wilmington—Conner (J.) & Son, 235 Market St. Goldenburg (L.), 200 Market St.

L. & H. Surplus Stores, 6 W. 4th St.—11.

DISTRICT OF COLUMBIA

Washington, D. C.—Capitol Surplus Co., 1009 H St. N.E.

Gichner (Jacob H.), 2513 M St. N.W.—2, 3, 19, 23, 27, 40, 45.

Globus Industries, 422 Washington Bldg. (A. P. Zimmer).

Manhattan Office Equipment Co., 1101 7th St. N.W., (J. Kressin).

National Surplus, 9th and D Sts. N.W.

Rice (S. W.) Co., 1342 G St. N.W.

Surplus Sales Co., 925 Pennsylvania Ave. N.W.—11, 24, 28.

FLORIDA

Jacksonville—Sutton's Government Surplus, 7840 Phillips Hwy.—11, 16, 24, 33, 40.

Clearwater—Howard The Trader, Box 990.

Fort Lauderdale—Blair's Army Store, 1509 S. Andrews Ave.

Jacksonville—Army-Navy Store, 24 E. Bay, R—11.

Berman Bros. Surplus Sales, 3305 Walnut—11, 24, 40.

Surplus Trucks & Equipment, 6286 Phillips Hwy.—3, 16, 44.

Miami—Army Salvage Co., 6160 N.W. 27th St. Eagle Tire Co., 3216 N.W. N. River Dr.—39.

Miami Surplus Sales, 3198 N.W. 36th St.—11, 24.

St. Petersburg—Jackson (Bill), 1055 4th St. S. Lance Store, 225 9th St. S.—11.

Sarasota—Jules Surplus Store, 1527 Main St.

Master Mechanic Manufacturing Co., 923 General Brett St., Box 65, Cat., W&R, Min. \$2—4, 6, 7, 14, 23, 25, 27, 40, 45.

Sebring—Thomas Aviation Sales, Box 529—2.

South Miami—Al's Army Store, 5922 S. Dixie Hwy.—11.

GEORGIA

Atlanta—Fulton Equipment Co., Inc., 2235 Stewart Ave.—44.

Illinois

Johnson's Gun Shop, 3143 Peachtree St.—21.
 U. S. Salvage Co., 618 Bankhead Ave. N.W.
Augusta—Southeastern Equipment Co., Inc.,
 518 13th St.—44.
Columbus—Dale's Hardware, 2018 Old Fort
 Benning Rd.—24.
 Surplus Hardware Outlet, 2208 Wynntown
 Rd.—24.
Macon—Famous Bargain Center, 446 Poplar St.
Savannah—H. & B. Enterprise, E. Victory Dr.—
 14, 16, 23.
 Salvage Sales Co., 228 W. Broad St.
Valdosta—Southern Salvage Co., Box 691.

HAWAII

Honolulu—Commercial Sales Co., 929 Auahi.
 Honolulu Truck & Equipment Supply Ltd.,
 Halawa Quarry—44.
 Kimi Surplus, 1336 Dillingham Blvd. (17).
 National Metals, Ltd., Box 2157, Pier 36—30.
 Surplus Center Stores, 556 S. Queen St. (13).
Maui—Wailuku Surplus, 2159 Main, Wailuku.

IDAHO

Boise—Koppel (Harry) Co., Fairview Ave., R.
 —11.
 Trader Horn, 2945 Chinden Blvd.—11.
Pocatello—McCarty's Inc., 658 S. 1st Ave.
Twin Falls—Davis Motor Co., 215 Main Ave. W.
 Surplus Sales Army & Navy Store, 251 Main
 Ave., W.

ILLINOIS

Aurora—Bender's Store, 29 N. Broadway.
Brookfield—Suburban Surplus Stores, 9513 Og-
 den Ave.—11, 24, 40.
Champaign—Freight Sales, 410 N. Neil St.
Chicago—AA Auto Generator & Electrical Co.,
 7827 S. Racine—40.
 A & H Truck Parts Inc., 1731 S. Canal St.
 Abbott Bearing Co., 1818 S. Wabash—6.
 Ace Industrial Surplus Co., 936 W. 37th—32.
 American Science Center, 5700 Northwest
 Hwy., R.—33.
 Appleton Electric Co., 1713 Wellington Ave.
 (13)—16, 40.
 Berg Truck Parts Co., 1608 S. Wabash Ave.
 Bohn (L. A.) Co., 2132 S. State St.—3.
 Bulldog Marine Products Co., 5825 S. Western
 Ave. (Barry W. Splinter)—28, 29.
 Capitol Commodities Co., 4757 N. Ravens-
 wood—17.
 Central Iron & Metal—Div. of Central Waste
 Material Co., Inc., 2455 N. Elston—30.
 Cobb-Whyte-Laemmer Co., 325 S. Halsted—
 24, 32.
 Consumers War Surplus Store, 835 W. 79th.

Cook County Machinery Co., 1034 W. Lake St.
 —40.
 Delott Supply Co., 1600 S. Dearborn St.—
 15, 16, 32, 35.
 Drake Stores, 11363 S. Michigan—11.
 Dunker Industries Inc., 8140 S. Hoyne.
 Electrical Motors Salvage, 636 S. Dearborn—
 16, 30.
 Famous Surplus Outlet, 8959 S. Commercial
 —11.
 Federal Surplus Sales, 571 W. Roosevelt—
 11, 24.
 General Tool & Plumbing Salvage Co., 1895
 N. Milwaukee—35, 40.
 Gordon Bros. Iron & Metal Co., 1334 W. Lake
 —30.
 Graff Machinery Tool Co., 820 W. Lake St.—
 40.
 Groban Supply Co., 1139 S. Wabash—1, 14,
 16, 25, 40.
 Illinois Manufacturing & Supply Co., 1829 S.
 State St. (16)—11, 14, 23.
 Inssco Inc., 867 S. May St.—16.
 International Surplus & Sports Store, 6519 S.
 Halsted—11.
 Irving Joseph Inc., 5959 W. Fullerton Ave.
 (39)—17.
 Klein's Sporting Goods, 227 W. Washington
 Blvd. (6), R, Min. 10%.
 Lee Salvage Co., 3813 N. Western.
 Levin & Fink Inc., 3347 N. Clark St.—15.
 Linderman (S.) Salvage Co., 1227 S. Kedzie.
 Lipman Sales, 4749 N. Rockwell (25), (Oscar
 Lipman)—17.
 Mann (Morris M.), 636 S. Dearborn St.—16.
 Marko Surplus Stores, 602 S. State St.—11,
 24.
 Marshall (C.) Sales, 3546 W. Fullerton Ave.
 (47), R, Cat., Min. 25%—16.
 Mid America Co. Inc., 6101 N. Broadway
 (26) and 2412 S. Michigan Ave. (16),
 W&R—17, 32, 36, 42.
 Miller (Samuel) Co., 323 S. Wacker Dr. (6).
 Monroe Fabricators, Inc., 1601 S. Michigan.
 National Purchasing & Supply Co., 4200 Nor-
 dica (38)—32.
 Newark Electronics Corp., 233 W. Madison
 St. (6), W&R—17.
 Northwest Surplus Outlet, 4803 W. Chicago
 Ave.
 Oakley (Otis) Iron & Supply Co., 2500 W.
 Fullerton (12).
 Peters (Ernie) Surplus Co., 2541 S. Indiana
 Ave. (16), (Ernie Peters)—3.
 Prehler (Norbert) & Sons, 1625 Milwaukee
 Ave. (47), Cat., R—6, 40.
 R. W. Electronics, Inc., 2430 S. Michigan Ave.
 (16), Cat., R, Min. COD \$10, 25% Dep.—17,
 18, 31, 36, 43.
 Rail & Truck Salvage Sales, Inc., 5855 W.
 North Ave.

Illinois

Railroad Salvage Stores, 1437 W. Madison.
 Roberts Electric Co., 849 W. Grand Ave. (22)
 —16, 23, 25.
 Royal Surplus Sales Co., 1058 N. Damen Ave.
 (22)—24, 40.
 Rube's Trading Post, 4345 W. Madison Street
 (24).
 Schreck Wholesale Inc., 1509 W. Barry Ave.
 —11, 24.
 Schwartz Salvage Co., Inc., 2310 S. Kedzie
 Ave.
 Seide (Wm. H.), 139 N. Clark.
 Sherman (H.) Sales Co., 5041 S. Cottage
 Grove (10), W&R.
 Silco Corp., 2121 S. Racine Ave. (8), (I. J.
 Silverman).
 Skinner (Harry E.) Co., 1949 N. Kenmore
 (14).
 Stark's, 212 W. Madison St. (6), W&R—11.
 Surplex Sales, 2409 S. LaSalle St. (16), (J. M.
 Andalman)—6, 13, 24, 32.
 Telephone Repair & Supply Co., 1760 W. Lunt
 Ave. (26).
 Tenenbaum (Merle S.) & Co., 7056 N. Clark
 St. (26)—28, 29, 40.
 Truck Ignition & Booster Co., Inc., 2119 S.
 Wabash—29, 44.
 United States Surplus Sales, 3421 W. Roose-
 velt Rd.
 United Surplus Trading Co., 445 N. Clark.
 Used Tire Sales, 19 E. 21st St. (16), 20%
 Dep. on COD.
 Wabash Truck Part Co., 1720 S. State St.
 (16)—45.
 Weiner (Stanley), 124 S. Franklin.
 Werner (Siegmond) Co., Inc., 3951 S. Canal
 St.—11, 28.
 Wessex, Inc., 1222 S. Michigan Ave. (Harry
 Bernbaum)—11.
 Westheimer Surplus, 323 W. Polk (37).
 Wilt Surplus, 7827 S. Racine—40.
 Winner Sales Co., 1395 N. Milwaukee Ave.
 World Famous Sales, Inc., 1603 S. Michigan
 Ave. (16), (Joe Pinkwater).
Danville—Gildersleeve's, 129 E. Main St.
Decatur—Macon County Tractor Parts & Sup-
 ply Co., 2505 N. Jasper—41.
Dekalb—Lloyd's, 134 E. Lincoln Hwy.
Elgin—Elgin Salvage & Supply Co., Inc., 464
 McBride St.
Evanston—Martin Electronics, Box 628—17, 36.
Joliet—Railroad Salvage Store, 667 Collins.
Moline—Harris (A. D.) Co., 2935 4th Ave.—
 11, 17, 33, 40.
Oak Park—Lloyd's Surplus, 1132 N. Euclid St.
Pekin—Union Store, 315 Court.
Peoria—Harris (S.), 507 S. Adams St.
 Lens & Camera Shop, 135 S.W. Jefferson Ave.
 —10.
Quincy—Quincy War Surplus, 507 Hampshire
 St.

Merkel Bros. Hardware, 1711 Broadway—24.
River Grove—Coleman Cable & Wire Co., 1900
 N. River Rd.—45.
 Siedlar (S.) Machinery & Equipment Co.,
 8116 Grand—16.
Rock Island—Harris (A. D.) Co., 500 40th St.
 —11, 17, 33, 40.
Rockford—Warshawsky's, 431 S. Main.
Springfield—Cannon Store, 609 E. Washington
 —11, 40.
 Industrial Steel & Surplus, 1810 W. Jefferson
 —30.
 National Salvage Co., 2156 S. 12th St.
 Martin Brothers Hardware & Electronics,
 1420 S. 10½ St. (Charles A. Martin), Cat.,
 W&R, No. Min.—17, 19, 32, 38, 40, 42.
 Myers Brothers, 101 S. 5th St.
 Railroad Salvage, 2001 E. Mason.
Urbana—Teppek's, 119 W. Main St.
Wheeling—Wheeling Trading Post, 260 S. Mil-
 waukee Ave., W&R—11, 15, 16.

INDIANA

Elkhart—Century War Surplus, 111 S. Main St.
Evansville—Baker & Co., 1014 Main St.
Fort Wayne—Fort Wayne Truck Parts & Equip-
 ment, Inc., 3101 Maumee Ave.—44.
 Reliable Stores, Inc., California & Lima Rds.
Gary—I. & L. Surplus Mart, 8425 Pine Ave.
 Sports World, 561 Broadway—11.
Hammond—Calumet Surplus, 469 State St.
 Railroad Salvage, 487 Michigan Ave.
Indianapolis—Cohn (S.) & Son, 142 W. Vermont
 St. (4)—41.
 Esse Radio Co., 42 W. South St.—12, 14.
 Hoosier Tarpaulin & Canvas Goods Co., Inc.,
 1302 W. Washington St. (Robert Goldberg)
 —11.
 Surplus Sales Co., 343 Massachusetts Ave.
 (4), (Lou E. Levy).
LaPorte—Groman's Workman's Store, 121 Pine
 Lake Ave.
Marion—Pope Foundry & Machine Co. Inc.,
 33rd & Adams (Robert M. Pope)—40.
Michigan City—Industrial Utilities Inc., 3013
 Northmoor Trail (Edward J. Kelley), W.
Muncie—Roth's Army & Navy Outlet, 108 W.
 Charles—11.
New Albany—P. A. Niemaier, 222 State St.
Paoli—Paoli Surplus Center, 204 W. Water St.
Peru—Carlisle Army-Air Force Surplus, 113
 S. Broadway.
South Bend—Prairie Salvage & Surplus, 1514
 Prairie Ave.
 Salay Speed Equipment, 1851-53 Prairie Ave.
 —41.
Valparaiso—Benton's Hardware, 70 Washing-
 ton St.—24, 40.

Massachusetts**IOWA**

- Burlington**—Manufacturers Surplus Outlet, Inc., Agency Rd.
Cedar Rapids—Cedar Rapids Bargain Center, 318 1st St. S.E.
Des Moines—Hermann's Salvage Store, 407 E. Locust.
 Pochter's Railroad Salvage, 503 S.E. 7th St.
 Robinson Surplus, 216 2nd St.
 Witten & Sons—41.
Fort Dodge—O.K. Tire Shop, 2804 5th Ave. S. (Bill Oswald)—39.
Sioux City—Atlas Instrument Co., 611 Pearl St.—40.
 Sioux City Paper & Barrel Co., 120 Iowa St. (Sid Shapiro).

KANSAS

- Hutchinson**—The Mart, 7 N. Main St.
Kansas City—Factory Outlet, 502 Minnesota Ave.
Pittsburg—B.&J. Army Surplus, 315 N. Broadway.
Salina—Block Sales Co., 717 N. Santa Fe.
Topeka—Farm & Home Equipment Co., 920 N. Kansas St.
Wichita—Airplane Surplus Co., 3055 N. Broadway—2.

KENTUCKY

- Frankfort**—Army Surplus Store, 317 W. Broadway.
Lexington—Lan-Mark Surplus, 361 W. Main.
Louisville—Army Bargain Center, 303 E. Jefferson—11, 40.
 Debrovy (Hyman) & Sons, 326 E. Market St. (Hyman Debrovy), R—11, 30, 40.
 G&K Co., 639 W. Main—11.
 Nussbaum (Carl) Jr., 1719 W. Main—11, 24, 40.
Owensboro—Bargain Supply, 305 E. Main St.
Paducah—Boy Stores, 201 S. 3rd St.

LOUISIANA

- Alexandria**—Fair Store, 1025 2nd St.
Lake Charles—Borderland Salvage, 1301 Broad St.
New Orleans—Marine Exchange, 601 Canal St.—28, 29.
 Marine Supply & Salvage Co., 1220 S. White—28, 29.
 Meyer's Auto Parts, 820 Dryades St.—3.
Shreveport—Barksdale Military Supply Co.

MAINE

- Bangor**—S&S Army-Navy Surplus, 105 Main St.
Fort Kent—Baker's Appliance.
Portland—New England Army Supply Co., 278 Congress—11.
Saco—Saco Steel Co., 2729 Water St. (Irving Zaitlin)—16, 30, 44.
South Portland—Alpren (Meyer), 169 Front—11, 30.

MARYLAND

- Baltimore**—Continental Iron & Metal, Ostend & Ridgley Sts. (Samuel Lazinsky)—30.
 Essex Manufacturing Co., 231-235 N. Franklinton Rd. (Louis N. Lehman).
 H&H Surplus Center, 1104 W. Baltimore—11.
 Herr Electric Co., 5200 Curtis Ave.—16.
 Industrial Sales Co., Inc., 1818 Patapsco St. (30), (Louis S. Schloss, Charles Keyworth), Cat., W&R—30, 32, 37, 40, 45.
 Sunny's Surplus Stores, 239 N. Franklinton Rd.—17, 24.
Bethesda—Super Surplus Centers, 8008 Wisconsin Ave.
Bladensburg—Atlas Salvage Corp., 4556 Tanglewood Dr.
Cumberland—The Hub, 19 N. Center St.
District Heights—District Heights Surplus Store, 7126 Marlboro Pike—11.
Hagerstown—Antietam Auto Parts, Box 715, 449 Antietam Dr. (Sidney S. Metzner)—3, 16.
 Maryland Pipe & Metals, 304 W. Church St. (Sidney Metzner)—30.
Silver Spring—Super Surplus Centers, 8500 Georgia Ave. (Don Dunnington)—11, 22.

MASSACHUSETTS

- Allston**—Jordon Distributing Co., Inc., 135 Brighton Ave. (34), (Harry S. Levinson).
Boston—Atlantic Mill Supply Co., Inc., 365 Dor Ave.—15, 24, 40.
 Blue Hill Electric Supply Co., 20 Blue Hill Ave.—3, 16, 24, 40.
 Electro Sales Co., 50 Eastern Ave., (Albert L. Berg)—7, 16, 18, 23, 42.
 Exter Co. (The), 320 Newbury St. (Frederic A. Sharf)—11.
 Hilton's War Surplus, 272 Friend St. (14)—28.
 Manganese Steel Parts Div., 53 Gerald St. (19)—44.
 Radio Shack, 730 Commonwealth Ave.—17.
 Vigor (Billy) Surplus Co., 382 Atlantic Ave.—11, 24, 28

Massachusetts

- Braintree**—Quincy Grossman Surplus Co., Inc., Union Exit, Southeast Expressway (Paul C. Shauk)—5, 6, 7, 8, 14, 16, 17, 23, 24, 29, 30, 32, 34, 40, 42, 43, 45.
- Chelsea**—Gans Surplus Tire Co., 1005 Broadway—39.
- Lektron, Inc.**, 243 Everett Ave. (50), Cat., R, Min. \$2, 25% Dep.—15, 16, 17, 18, 31, 36, 40, 42, 43.
- Rudco Sales**, 714 Broadway (George Rudolph)—15, 17.
- Lawrence**—Nassar (H. J.) Motor Co., Inc., 32 S. Broadway—44.
- Lynn**—Jerry's Inc., 48 Munroe—11, 24, 40.
- Meshna (John) Jr.**, 19 Allerton, Cat., W&R—5, 9, 17, 18, 19, 31, 36, 42, 43.
- Pennyworth's Inc.**, 23 Munroe—11.
- Salem Army & Navy Store**, 18 Central—11.
- Pittsfield**—Berkshire Hills Shops, 219 North St.
- Quincy**—Ticoa Tire Co. of America, 490 Washington St., W&R—39.
- Springfield**—Gordon's Army & Navy Stores, 1747 Main St.—11.
- Surplus Outlet Co.**, 2056 Main St.
- Worcester**—General Trading Co., Box 335 (1).
- Pioneer Trading, Inc.**, 95 Prescott St.
- War Surplus Store**, 536 Main St.
- Willimansett**—American Machinery Co., Olive St. (T. A. Barowsky)—16.

MICHIGAN

- Ann Arbor**—Proper (Charles H.) Co., 2231 Platt Rd.
- Benton Harbor**—Aircraft Components, Inc., Box 289.
- Detroit**—Anco Tool Supply, 12957 Hamilton Ave. (3)—40.
- Barry Surplus**, 10532 Grand River.
- Electronic Sales**, 80 Winder St. (1)—17, 18, 43.
- Machinery Liquidating Co.**, 2667 Michigan Ave. (16), (Ben Weiss).
- Michlin Surplus Co.**, 9045 Vincent (11), (Norman Michlin)—13, 40.
- Sam's Radio Surplus**, 14401 Meyers—17.
- Standard Auto Supply Co.**, 1361 Gratiot Ave., (Samuel Burns)—3.
- T & T Tool**, 5100 Grand River—40.
- U. S. Industrial Tool & Supply Co.**, 8948 Greenfield (28)—40.
- Flint**—Buy-Way-Stores, 5000 North Dort—11, 40.
- Grand Rapids**—Michigan Surplus, 132 S. Division.
- Olson Brothers**, 706 W. 28th St.
- Jackson**—Ginsburg's Motor & Surplus Sales, 1401 Wildwood—14, 16, 23, 24, 40.
- War Surplus Store**, 212 E. Michigan—11.
- Kalamazoo**—Stafford Hardware, 1722 W. Main St.—24, 40.

- Saginaw**—Army & Navy Store, 123 N. Jefferson—11, 22.
- Army Surplus Store**, 719 Lapeer—11.
- Tupes of Saginaw, Inc.**, 402 Davenport St.—41.
- Valley Surplus & Supply Co.**, 907 N. Washington—15, 16, 17, 24, 35, 40.
- Three Rivers**—Army Surplus Auto Supply, 182 E. Michigan.
- Warren**—Wholesale Tool Co., Inc., 12800 E. 9 Mile Rd. (Mike Travis), Cat., W&R, 25% deposit on COD, Min. order \$5—12, 14, 16, 25, 32, 40, 42.

MINNESOTA

- Duluth**—West End Surplus Store, 2024 W. Superior—11.
- Hibbing**—Mesaba Service & Supply, Box 121, Highway 169 E. and 13th St.—44.
- International Falls**—Greater Surplus Outlet, 415 3rd St.
- Minneapolis**—Enterprise Liquidators, Inc., 625 Plymouth Ave. N.—17.
- Federal Sales Div.**, Harris Machinery Co., 503 30th Ave. S.E. (14).
- Honeywell Salvage**, 605 W. Broadway.
- Midwest Sales**, 307 Upper Midwest Bldg. (1).
- St. Paul**—R. R. Unclaimed Goods, 848 Payne.
- Rosenthal (H.) Co.**, 140 6th St. (Marvin Smith), Cat., W&R.
- Virginia**—Virginia Surplus Store, 206 2nd Ave. N.

MISSISSIPPI

- Biloxi**—Bradley's, 214 W. Howard St.
- Southern Marine Equipment & Supply**, East Beach.
- Gulfport**—Firestone Home Auto Supply, 1410 25th Ave.
- Jackson**—Harrison (Jack) Salvage Co., Highway 80 W., R—11, 24, 40.
- War Surplus Store**, 157 E. Pearl.
- Vicksburg**—Louis Trading Post, 1600 Washington.

MISSOURI

- Joplin**—Hornaday's, 702 Main St.
- Kansas City**—Atlas Equipment Co., 229 Southwest Blvd., (Harry Adreme)—11, 16, 44, 45.
- Baxter (Fred) & Co.**, 535 Grand—1.
- Famous (The) Stores**, 2506 E. 63rd—11, 24, 40.
- General Salvage**, 2922 E. 27—11, 24, 40.
- General Tool Co.**, 1439 Grand—24, 40.
- Harlan Industries**, 922 Independence Ave.—11, 24, 40.

New Mexico

NEW JERSEY

Kaufman (Harry) Co., 1311 West 13th Street—11.
 Nelson Sales Co., 620 Broadway, (5), (Frank Nelson)—11.
 National Surplus Sales Co., 1800 Charlotte St. (8), (Thomas Millstein), Cat., W&R, Minn. \$10—1, 2, 4, 7, 14, 16, 17, 19, 23, 24, 31, 33, 36, 40, 42.
 Union Steel Co., 1726 Locust—24, 30, 40.
 Rolla—Dean (W. E.), Box 241 (Don Smith).
 St. Joseph—Hockman's Surplus, 513 Edmond St.
 St. Louis—Alper's Jobbing Co., 1409 Franklin Ave.
 Banner Hardware, 921 N. 6th St.—24, 40.
 Charter Tire Co., 1432 Mullanphy St. (6)—39.
 Surplus Liquidating Co., 2939 Olive St.
 Springfield—Woodside's Surplus City, W. Highway 166—11.

MONTANA

Billings—Joe's Bargain Center, 20 N. 27th St.
 Butte—McCarthy's, 26 E. Park.
 Great Falls—B & J Trading Post, 218 Central Ave.—11.
 Montana Trading Post, 600 Central Ave.
 Helena—Country Store (The), 1419 Helena Ave.
 Missoula—Grant's Army Store, Box 1423.

NEBRASKA

Grand Island—Dub's Army Sports Store, 1917 N. Broadwell.
 Lincoln—Acme Tractor Supply Co., 1041 N. 14th St.—44.
 Surplus Center, 900 W. O St.—11, 14, 16, 17, 23, 25, 31, 33, 40, 42.
 Omaha—AAA Salvage Co., 1617 N. 24th.
 Benson Trading Post, 4619 Fontenelle Blvd.
 Morton Co., 141 N. 35th Ave. (31).

NEVADA

Las Vegas—Veterans War Supply, 1613 Fremont St.
 Reno—Arian J. Co., 1 Plaza.
 Supply Sergeant, N. Virginia & Plaza—11.
 Surplus Outlet, 239 N. Sierra, R.

NEW HAMPSHIRE

Keene—Army & Navy Store, 14 Railroad St.
 Laconia—Alterman's Army-Navy, 24 Canal St.
 Manchester—Lynch's Sport Equipment, 770 Elm St.
 Mickey Finn, Inc., 1137 Elm St.
 Nashua—Army-Navy Store, 10 Spring St.

Barrington—Edmund Scientific Co., 101 E. Gloucester Pike (N.W. Edmund), Cat., W&R, Min. \$2.—7, 23, 27, 31, 33, 38.
 Bayonne—Sklar (Robert), 27 W. 25th St.—16.
 Belle Mead—Labawco Pumps (31)—14.
 Belleville—Reichman Co., 14 Carmen Ave. (9), (Julian F. Reichman)—17.
 Bloomfield—Werner (Siegmund) Co., Inc., 225 Belleville Ave.—11, 28.
 Bridgeton—Lahn (Meyer) Enterprises, 515-35 N. Bank St. (Meyer Lahn).
 Englewood—Palisade Army & Navy Store, 84 W. Palisade Ave.—11.
 Ephraim—Electric Surplus Buyers, 505 W. Kings Hwy.—15.
 Hackensack—Haynes Equipment Co., Inc., 58-62 Voorhis Lane—40, 45.
 Outdoor Army Store, 76 Main St.—11.
 Hoboken—Academy Metal Products Co. Inc., 611 Jefferson St. (Arthur Kaufman)—30.
 Wire Rope Trading Co., 17th & Willow (Arthur Tucker)—45.
 Irvington—Leven (J.) & Co., 109-115 S. 20th St. (11), (Milton Leven)—24.
 Iselin—Atlantic & Pacific Trading Post—40, 16, 44.
 Jersey City—Ace Iron & Metal Co., 935 Communipaw Ave.—16, 24, 30.
 Maxwell Hilton & Co., 578 Grove—13.
 Production Metals Inc., 299 Pavonia Ave. (2), (Aubrey L. Moss), Cat., W—30.
 Surplus Merchandise Dealers, 408 Communipaw Ave. (Abraham Nutkis)—10, 17.
 Lyndhurst—Appalachian Steel Corp., Schuyler & Page Aves. (H. N. Goettlich)—30, 44.
 Newark—Morris Machinery Co., 93 Chestnut St. (5), (Frank Morris).
 Rad-Tel Tube Co., 55 Chambers St. (5), Cat., W&R, Min. order \$5. 25% dep.—18, 43.
 Orange—Barney's Bargain Store, 167 Main St.
 Zelin's Army & Navy Store, 225 Main St.
 Paterson—Behrman's, 222 Main St.
 Upton (George A.), 434 Knickerbocker Ave.
 Perth Amboy—Plant Surplus Co., 25 2nd St.
 Trenton—Eastern Scrap & Salvage Corp., 65 Muirhead Ave.—44.
 Lipman's Army & Navy Store, 22 Perry—11.
 Snyder's Army & Navy Store, 107 Perry—11.
 Star Textile Co., 865 S. Broad St.—11.
 Woodbridge—Atlantic & Pacific Trading Post, 826 U. S. Highway No. 1—14, 16, 23, 40.

NEW MEXICO

Albuquerque—Barn (The), 13203 Central Ave. N.E.—11, 16, 35, 40.
 Bell Sales & Salvage, 1309 4th S.W.—11, 16, 24, 40.

New Mexico

- Disabled Veterans Industries, 1023 4th S.W.—36.
 Essary Sales & Salvage, 7614 4th N.W.—1.
 Gizmo Army Store, 113 Central Ave. N.W.—11.
 Carlsbad—J&J Trading Co., 515 S. Canal St.

NEW YORK

- Albany**—Allen Hardware Co., 754 Broadway—24.
Bayport—Williams Aviation Supply, Davis Field—1.
Bayside—Bayside Surplus Outlet Inc., 40-08 Bell Blvd.
Binghamton—Harris Army & Navy Store, 167 Washington St.
Bronx—Commercial Controls Co., 1463 Crotona Pl. (Milton Becker)—15, 17.
 Refonics Sales Co., Inc., 536 E. Fordham Rd. (Sam Reff)—17.
 Rapaport (Joseph), 2984 3rd Ave. (55).
 Robbins Salvage Store, 1920 Webster Ave.
 Stewart (Harry) Co., 421 Longfellow Ave. (59)—40.
Brooklyn—A&J Equipment Corp., 1911 Neptune Ave. (24), (Arthur Dunn)—17, 24, 28.
 Able Electric Cable Co., 125 2nd St. (31), (Ian Imbey)—19.
 Ace Surplus Co., 8 Berry St.—14, 16, 28, 29, 30.
 Aluminum Mill Supply Corp., 44 Court St. (Bernard Grandis)—30.
 Barnett & Small, Inc., 768-778 E. New York Ave. (3), (Bertram Barnett, Arnold A. Small), W, Min. 25%—3, 6, 16, 17, 31, 38.
 Bristol Dynamics Inc., 219-233 Alabama Ave. (Melvin D. Douglas)—17.
 Canal Brass & Supply Co., 148 N. 10th St. (11), (Murray Ptashak), W&R—30.
 Crusader Trading Corp., 2075 Gerritsen Ave. (25), (Barney Schlags)—11.
 D.&G. Merchandising Corp., 2802 Suff Ave. (24), (David Gottlieb), W, Min. 50%—1, 5, 7, 24, 27, 28, 32, 45.
 Empire Electric Co. Inc., 5200 1st St. (22), (Ben Hasnas)—16, 23.
 Frankson Enterprises, 469 Kings Hwy. (A. Amstell).
 Klegerman (Henry), 515 Kings Hwy. (Henry Klegerman).
 Marval International, 223 Church Ave. (18), (William J. Harkins).
 Nickel Alloys Corp., 44 Court St., (1), (Bernard Grandis), Cat., W—30.
 Normandy Electric Wire Corp., 125 2nd St. (31), (L. W. Goody), Cat., W&R, Min. \$5—19.
 Rosben Import Corp., 555-557 Graham Ave. (22), (Ben V. Kohn), Cat., W—11, 24, 40, 44.
 Salzano (Edward), 5202 Flatlands Ave.—28.
 Tarashinsky Merchandise Co., 254 Manhattan Ave. (11), (Edward Tarashinsky), Cat., W&R—11.
 Weinberg (Jack), 348 Rockaway Ave.—15.
Buffalo—Fargo Electric Co., 259 Niagara St. (1), (Joseph R. Arno)—15, 16.
 Interstate Auto Parts, 636 Babcock Ave., (6), (Syd Freedland)—3, 24, 44.
 Seneca Surplus Co., 86 Seneca St.
Forest Hills, L. I.—Enkay Trading Co., Box 163, Forest Hills (Kurt Wolter), W&R, Min. \$10—24, 40.
Greenport, L. I.—Preston (S. T.) & Son, Inc., 102 Main St. (Charles Lees)—28.
Huntington, L. I.—Huntington Auto Parts, 215 Main St., (Sam Margules)—3.
Jamestown—Web Machinery Co., 620 W. 8th—14, 16, 23, 24, 32, 40.
Kingston—Shanty Store Inc., 326 Fair St.
Liberty—Sullivan Surplus Sales, Route 17.
Long Island City—A&G Sales Co. Inc., 32-70 31st St., (Andrew Gross)—3, 6.
 Advanced Alloys Inc., 47-29 Van Dam St., (Arthur Glassman)—30.
 H.S.R. Specialties Corp., 28-09 Jackson Ave. (1), (Harry Roday), Cat., W&R, Min. \$2.95—6, 32, 40.
 Long Island Exchange, 45-15 Vernon Blvd. (1)—11.
 Metropolitan Plumbing Supply Corp., 37-14 32nd St. (William Kane)—35.
 Morsan Tents, Inc., 10-21 50th Ave. (Morton Jarashow)—11.
 Outdoor Supply Co., Inc., 24-16 Bridge Plaza S. (William Simonoff)—11.
 Steelcraft Tool Corp., 36-50 31st St. (Sam Huberman)—40.
Lynbrook—Jaegers (J.), 691 W. Merrick Rd., R—33.
Malone—Malone Trading Post, E. Main & Raymond Sts.
Mamaroneck—All Boro Metal Products, 610 Fenimore Rd. (Jack Schnapp)—30.
Merrick—Robinhood Surplus, 2132 Sunrise Hwy.
New Hyde Park—Doro Aluminum Corp., 100 Herkimer St. (H. Wertheimer)—30.
 Trader Tom, 149 Covert Ave. (Kenneth J. Shears)—14, 16, 44.
New York—A&B Surplus, 465 W. Broadway (Alfred Saffar).
 A. M. Aircraft Parts Co., 307 Broadway (13)—1.
 Abbe Films & Equipment Co., 417 W. 44th St. (36), (William T. Abbe)—10.
 Abco Supply Co., 387 Canal St. (13), (S. J. Waldman), W&R (check with order, except with rated accounts) —1, 2, 4, 14, 15, 16, 23, 25, 27, 31, 38, 42.

New York

- Ace Industrial Supply Co., 186 E. 2nd St. (9)—32.
 Ace Surplus Co., Inc., 307 Canal St. (Al Hecht)—16, 30.
 Ajo Trading Corp., 1 Hudson St. (13), (Jack Gross)—3, 6.
 Aluminum Alloys Corp., 15 Park Row (38), (Harry J. Rapp)—30.
 Aluminum Metals Corp., 42 Broadway (4), (Gabriel H. Lyons)—30.
 Amco Brass & Steel Supply Co., 428 Broome St. (Morris Cohen, Abe Cohen)—30.
 American Jobbing Co., Inc., 164 Canal St. (13), (George Javian)—11, 45.
 American Surplus Trading Co., 332 Canal St. (Arthur Sadow)—17.
 Amity Merchandise Products Corp., 318 Canal St. (Monroe Ziegler)—2, 25, 30.
 Arkay Products Corp., 362 W. Broadway (Fred Katz)—11.
 Aronoff Service Products Co., 20 E. 30th St. (Max Aronoff).
 Ast Co., 150 5th Ave. (Philip Saltzman, Lynn Barnett)—17.
 Ball (N.) Supply Co., 648 Broadway (12), (Nat Ball).
 Barry Electronics Corp., 512 Broadway (12), (B. N. Gensley)—17.
 Benjack Sales, Inc., 655 Broadway (12), (Ben Schechter, Jack Rubenstein), W—11.
 Bond Metal Surplus Co., 321 Canal St. (13), (Jack Cooper), Cat., W&R, Min. \$5—30.
 Broadway Importing Co., Inc., 625 Broadway—11.
 Calvert Electronics Inc., 536 Broadway (12)—18.
 Canal Electric Motor, Inc., 310 Canal St. (13), (Anthony C. Mifsud), Cat., W&R—7, 14, 16, 23.
 Comart (Paul), 435 Broome St.—32.
 Communications Equipment Co., 343 Canal St. (13), Cat., W&R—17, 36, 42.
 Compass Instrument & Optical Co., 104 E. 25th St. (10), (Curtis Strauss), W—23.
 Crewall Tool Co., 401 Park Ave. S. (16)—40.
 Delancy Tool Co., 104 Reade St. (Max and Dave Baumrin)—24, 40.
 Derf Radio Co., 17 Hudson St. (13), (Fredrick G. Abt), Cat., W, Min. \$10—16, 17, 18, 19, 31, 38, 43.
 Dreyco Motor Products Inc., 201 W. 64th St. (Jack Dreyfus)—44.
 Edelson (J. J.), 654 Broadway (J. J. Edelson).
 Electromatic Equipment Co., 334 Canal St. (13)—71.
 Electronic Surplus Center Co., 359 Canal St. (Jay Schwartz, Bruce Barrett)—17.
 Famous Merchandise Co., Inc., 656 Broadway (12), (Ben Lissaur)—11.
 G.I.C. Sporting Goods, 141 E. 44th St. (17), (B. W. Morosco)—11.
 Globe Bolt & Screw, 435 Broome St., (13)—32.
 Goetz (Morton M.), 831 Broadway (13)—16, 19.
 Goldman (A.), & Sons, Inc., 625 Broadway (Harris and Larry Goldman)—11.
 Guardino & Schooler Associates, 227 Mott St. (Albert Guardino, Leon Schooler)—2, 45.
 Hardel International Inc., 42 Prince St. (12), (Sam Lavinsky)—17.
 Herman's, 135 W. 42nd St.—11.
 Hi-Test Premier Products, 361 Broadway (13), (Max Amper), Cat., W, Min. \$50—24, 32, 40.
 Industrial Plastic Supply Co., 324 Canal St. (13), (Max Landau)—34.
 Integrity Industries, Inc., 46 Great Jones St. (Norman Tulchin)—40.
 Jewel Yarn Co., 372 Broome St. (12), (Ben Katz)—27.
 Job Lot Trading, 53 Vesey Street (Sam Osman).
 Kass (Samuel) Inc., 59 N. Moore St. (13), (Murray Starobin)—17.
 Kaufman Army-Navy Stores, 319 W. 42nd St. (36), R—11, 33, 36.
 Kaufman Surplus & Arms, 623 Broadway (12), Cat., W&R—11, 33, 36.
 Knife Sales, 504 Broadway (Sam Gross, David Schuman), Sat., W—11.
 Latam Trading Corp., 348 W. 36th St. (18), (Sam Krieger).
 M&S Export Co., 506 Broadway, (Murray Greiff)—11.
 Mitchell Mogal, Inc., 440 Broadway (13), (Saul Mogal), W—21.
 Modells, 198 Broadway (Henry Modell)—11.
 Monodon Corp., 301 E. 42nd St. (17), (Harry E. Zucker)—2.
 National Office Equipment, 429 Broome St. (Irving Levy).
 Orange (Herman) Co., 30 E. 10th St. (13), (Herman Orange).
 Pioneer Trading Co., 331 Canal St. (13), (Murray Doenias), W&R—1, 2, 3, 4, 6, 14, 16, 23, 25, 27.
 Platt Sales, 23 Park Place (Murray Platt), W&R, Min. 20%—17, 42.
 Publicity Searchlight Service Corp., 38 W. 53rd St. (19), (George T. Wendelken), W&R, Min. 25%—23, 26, 28, 29.
 Radio Ham Shack, Inc., 66 Dey St. (7)—5, 17, 18, 31, 36, 42.
 Refrigeration Trading Co., 334 Canal St. (13), (Leo Jacobs)—16, 17.
 Rolins Co., 92 Front St. (5), (Arthur & Harry Rolins)—28.
 Ross, Harry, 61 Reade St. (7)—33.
 Rothenberg-Brody, Inc., 42 Elizabeth St.
 Specialty Hardware Co., 143 Chambers St. (7), (Phil Goddard)—40.

New York

- Stein (Nat) Co. Inc., 56 W. 45th St. (36), (Nathan Stein)—30, 44.
 Stevens Socket Screw Co., 51 Crosby St. (Irving Gartner)—32.
 Surplus Materials, Inc., 318 E. 23rd St. (10), (Norbert Hausknecht)—15, 24.
 Tunnel Machinery Exchange, 353 Canal St. (13), (Richard A. Sencer)—7, 14, 16, 18, 31, 32, 40, 42.
 Varkell, (Paul) Co., 37 W. 39th St. (18), (Paul Varkell)—2, 6.
 Victory Cable Co., Box 23, Triboro Station (35)—45.
 Niagara Falls—Border City Outlet Co. Inc., 360 3rd—11.
 Property Maintenance Service, 1115 Oak St., (Henry E. Wrobel).
 Oceanside—Globe Bolt & Screw Co., Lawsen Blvd. (Paul Comart)—32.
 Pam Narrow Fabrics, 2807 Long Beach Rd. (Bert Harris)—37.
 Olean—Zuckerman Bros., R.D. 2 (William Zuckerman)—17.
 Plainview, L. I.—Industrial Inventories Corp., Sunnyside Blvd. (Martin Hambros)—16, 30, 32, 40, 45.
 Richmond Hill—National Track Sales, Inc., 108-11 Jerome Ave. N.E.—41.
 Rochester—Bachman Wholesale Co., 1073 Clinton Ave. N.—11.
 Diamond (Morris) Associates Inc., 1025 Chili Ave. (Bernard S. Bachman)—1, 21.
 Rockville Centre—Rockville Centre Trading Post, 96 Sunrise Hway. (Leon Schwartz).
 Rome—J. & M. Optical Supply Co., 708 N. George St. (John Sheridan Kerman)—33.
 Schenectady—Hub (The), 206 State St. (5).
 Staten Island—E.&B. Surplus, 146 Canal St., Stapleton (4), (Ernie Bench), W&R—28.
 Staten Island Hardware Co. Inc., 1940 Richmond Terrace (2), (Lawrence Parish)—17, 24.
 Syosset—Lafayette Radio, 111 Jericho Tpke., Cat., W&R—17.
 Syracuse—Oneida Surplus Outlet, 263 Fenway Dr. Outdoor Store (The), 137 W. Onondaga—11.
 Utica—Reid-Sheldon & Co., 241 Genesee St.
 Watertown—Abe-Cooper Watertown Surplus, S. Factory Sq.—16, 23, 42.
 West Lebanon—Avery Tractor, Inc., U. S. Route 20, (Gilbert H. Avery)—25.
 Woodmere—Marcus (Harry P), 29 Woodmere Blvd.—30.
 Yonkers—Atlas Arms & Munitions Corp., 102 Ashburton Ave (Jos. T. and Thomas C. Restifo)—21.
 Folsom (H&D) Arms C. (The), 154 Ludlow St. (Irving Feldsott)—21.
 Scott Mitchell House Inc., 415 S. Broadway—40.

NORTH CAROLINA

- Charlotte—Charlotte Trading Co., 316 Trade St. Equipment & Supply Co. Inc., Box 9127—7, 16, 25, 29, 39.
 Durham—Auto Sales Exchange, 609 Liberty—3.
 Greensboro—Carolina Sales Co., 606 S. Elm—11, 40.
 Raleigh—Southern Surplus Store, 339 S. Wilmington.
 Wilmington—Turner's Bargain Store, 705 N. 4th St.

NORTH DAKOTA

- Fargo—Fargo War Surplus, 412 Front St. Twin Cities Army Store, 405 Northern Pacific Ave.
 Grand Forks—Grand Forks Surplus Outlet, 502 De Mers Ave.
 Mint—P. W. Miller Co., 108 W. Central.

OHIO

- Akron—Buckeye War Surplus Stores, 939 E. Market—11.
 Olson Electronics, 260 S. Forge St. (8)—9, 16, 17, 18, 19, 31, 36, 40, 42, 43.
 Schott (L. J.) Co., 1340 E. Archwood Ave., Box 7152 (6), (L. R. Schott).
 Surplus Materials Co., 100 Lincoln St. (8)—21, 32, 40, 45.
 Winer (Sam) Motors, Inc., 3417 E. Waterloo Rd.—26, 44.
 Alliance—Factory Surplus Store, 615 E. Main St.
 Canton—Canton Industrial Salvage Co., 1510 S. Market Ave.—37, 40, 44, 45.
 Surplus & Supply, 221 Cherry St. N.E.
 Wilkof Steel & Supply Co., 1060 Warner Rd. S.E. (Ervin Wilkof)—16, 30.
 Cincinnati—Albert's Western Wear, 101 E. Court St. (2), (Charles S. Albert)—11.
 Effron's Surplus, 7155 Eastlawn (37).
 F&M Supply Inc., Crookshank & Glenway—15, 24.
 Queen City Surplus, 132 Reading Rd. (37).
 Cleveland—Bennett Sales, 1309 Washington Blvd. (Norman Bennett).
 Berger (The J. W.) Co., 6116 Broadway (27), (J. W. and M. Berger)—11.
 Stern (Sam K.) Surplus, 13911 St. Clair.
 Premier Sales Co., 14716 St. Clair—11.
 Superior Tool Co., 6609 Carnegie—40.
 Surplus City, 13107 St. Clair—11, 40.
 Udelson Equipment Co., Box 5191, 3210 Woodland Ave. (15)—44.
 Waag Enterprises, 3110 Broadview—2, 3, 29.
 World Surplus, 3833 Sieby Rd.

Pennsylvania

OREGON

Cleveland Heights—All Sales, 13440 Cedar Rd., Box 3584 (18), (Allen E. Bertman), W&R—17, 24, 25, 31, 32, 38, 43.

Columbus—Fox-Wood Surplus Sales, 954-6 N. High St. (Woody Pickering, Ray Fox)—1, 3, 17, 24, 40.

Ludlow Sales, 1763 High St.

Masser (Harry) & Co., 485 E. Livingston—11, 24, 40.

Rosen Parts Co., 548 E. Main St. (15)—44.

Shenco Sales Co., 2115 S. High St. (7)—3, 6, 15, 17, 23, 35, 39, 40, 44, 45.

Starr Surplus Sales Co., 1038 N. High St.—17.

Surplus City, 2945 Westerville Rd.—11, 24, 40.

Topper Steel & Supply Co., 2108 S. High St.—2.

General Surplus, 339 E. 3rd—11, 40.

Dayton—Nate's Cut Rate, 7500 Frederick Rd. (14).

Elyria—Elyria Belting & Machinery Co. (The), Williams and Buckeye Sts.—12, 25, 40, 45.

Hamilton—Wente Electric Co., 209 N. 4th St. (16).

Lancaster—Lico, Box 327—25.

Lima—Fair Radio Sales, 2133 Elida Rd., Box 1105 (Joe Sellati), Cat., R, Min. order \$3, 25% dep. on COD order—7, 16, 17, 19, 23, 31, 33, 36, 42.

Surplus Stores, 354 E. Market St.—16, 22, 40.

Lorain—Cane's Surplus, 573 Broadway.

Marion—Marion Iron & Metal Surplus, 458 W. Center.

Massillon—Surplus Sales Equipment Co., 4325 Lincoln Way—44.

Springfield—Main Surplus Store, 112 W. Main St.

Toledo—Midwest Salvage Co., 124 Summit St. Ontario Equipment Co., 986 W. Central Ave. (1)—16, 23, 42.

Reddish Brothers Hardware, 923 Starr—24, 40.

Sanford's, 313 Summit St. (4).

Youngstown—General Surplus Sales, 5472 Mahoning Ave.

Reiter (H. B.), Box 1033, 812 Franklin Ave.

OKLAHOMA

Oklahoma City—House of Bargains, Box 9051 (15).

Kenny's Surplus Sales, 2534 N. McArthur.

World Wide Electronics, 28 Broadway Circle.

Stillwater—Reed's Surplus Store, 912 Main S.

Tulsa—P & S Sales, Box 4700—11, 21, 37, 40.

Peacock (R. E.) Central Co., 3940 Memorial

Dr. (14), (Ralph Peacock), Cat., W, \$1.50

Packing charge on order under \$35—3, 11, 21, 33, 38, 33, 37, 40.

Zeligson Truck & Equipment Co., 6707 E. Admiral Pl.—44.

Eugene—Allied Surplus Sales, 735 Willamette—11.

Klamath Falls—Hal's Sport Shop, 532 Main St.—11.

Medford—Hobbs Trading Post, 1802 W. Main St.

Portland—Andy & Box Surplus, 1234 S.E. Union—8, 11, 24.

Division Surplus, 3564 S.E. Division—11, 24.

G. I. Joe's Surplus Store, 8700 N. Vancouver Ave.—11.

Gateway Surplus, 103rd & Halsey—11.

Saltman (D), War Surplus Supply, 924 S.W. 1st Ave.—11, 24.

Wigwam General Mdse., 10209 N.E. Sandy Blvd.—11.

PENNSYLVANIA

Allentown—Fifth Street Bargain House, 1022-1032 S. 5th St. (Robert C. Moyer).

Neff Brothers, 2611 Washington St. (51).

Altoona—Surplus Outlet Inc., 6th Ave. and 40th St.

Butler—Tri-State Sales Co., Box 862.

Chambersburg—Memphis Equipment Co., 821 Lincoln Way W. (branch)—39, 44.

Roman's Surplus Trucks & Parts, R.D. 2 (John A. Roman)—44.

Dauphin—Atlas Surplus Sales, Peters Mountain Rd.—11, 40.

Erie—American Surplus Stores, 501 State St.—11, 40.

Press (L) & Co., 1216 State St.

Havertown—Berg (Hary) Inc., 2535 Woodleigh Rd.

Kingston—Franconi Auto Parts, 584 Market St.

McKeesport—Giant Outdoor Stores, 226 5th Ave.—11.

Ideal Army & Navy Stores, 626 Walnut St. (Ben B. Marcs)—11, 17, 22.

Monroeville—Forbes Motor Co.—44.

New Castle—Merrilees (Bruce) Electric Co., 648 E. Washington St.—15, 23, 42, 45.

Paul & Al's Army & Navy Stores, 107 E. Washington St.—11, 22.

New Kensington—Bettors Army & Sports Store, 856 5th Ave.—11.

Norristown—Army & Navy Store, 301 E. Main St.—11.

Palmyra—Berman (J.) & Sons, Inc., 118 E. Front St.

Philadelphia—Albert Kaplan Industrial Supplies American and York Sts. (33)—20.

Breggar & Ciplet, 1938 Market St.—11.

Capt. Joe's Surplus Stores, Inc., 1028 Arch St. (7), (Joseph Fineberg), W&R—6, 16, 17, 24, 25, 30, 33.

Pennsylvania

Dalton Supply Co., 2181 E. Huntington St. (David Rosenthal).
 Dave's Army & Navy Store, 1404 W. Susquehanna Ave.—11.
 Delaware Equipment Co., 124 N. 3rd St.—11, 15, 16, 17, 24, 40.
 Dubin Steel Co., 1015 Chestnut St. (7), (Henry Dubin)—30.
 Electronic Laboratory Supply Co., 7208 Germantown Ave. (19), (Mathew Conrad)—17.
 Federal Merchandise Co., 6513 N. Broad St.—20.
 Gail (H. F.) Sales Co., 307 Cherry St. (6), (Harry Gail)—40.
 Goldberg's, 202 Market St.—11.
 Goldberg (I.) & Sons, Inc., 429 Market St. (Charles Goldberg).
 Herbach & Rademan Inc., 1204 Arch St. (7), (Norman O. Rademan), Cat., W&R, Min. \$2—1, 5, 7, 9, 14, 16, 17, 18, 19, 23, 24, 27, 31, 38, 42.
 Humphry (R. A.) & Sons Inc., 1241 Carpenter St. (47), (N. H. Nissenbaum)—11.
 Kaplan (Morris) & Bro., American and York Sts. (33), (Albert Kaplan).
 Kessler (Stanley) & Co., 20th & Atlantic.
 Lawrence Sales Corp., 2501-33 Kensington Ave. (25).
 Micsko (Charles J.) Jr., 5960 Alma St.—30.
 Pennsylvania Wholesale Distributors, 104 6th St. (6), Cat., W&R—7, 14, 16.
 Polly Bros., 3227 Kensington Ave.—11, 28.
 Rea-Back Associates, 3502 Mt. Vernon St. (Louis Reaback).
 Reliable Stainless Steel Co., 3318 Memphis St. (Danny Holtzman)—30.
 Ryans Inc., 5839 Germantown Ave.—11.
 Seaboard Industrial Supply Co., 151 N. 3rd St. (Irving Koplin)—16, 40.
 Selectronics, 1207 S. Napa St. (46), (Milton Silver), Cat., W&R, Min. \$5—4, 7, 9, 17, 18, 19, 27, 31, 36, 45.
 Shannon (J. Jacob) & Co., 214 N. 22nd St. (3), (Harry H. Goldberg)—11, 20, 28.
 Stantex Corp., 40 N. 2nd St. (Stanton Bernstein)—11.
 Pittsburgh—Army-Naval Stores Co., 116 Smithfield St.—11.
 Berger (M.) & Co., 1816 Locust St. (Meyer Berger)—11, 12, 14, 20, 23, 40.
 Broadway Shop, 826 Liberty Ave.—11.
 North Side Army Store, 1812 Beaver Ave.—11.
 Outdoor Army & Navy Surplus Inc., 1604 Saw Mill Run Blvd.—11.
 Sieg's Army & Navy Department Store, 909 Liberty Ave.—11, 24, 33.
 Triangle Surplus Stores, 619 Braddock Ave.
 Reading—Surplus Outlet Store, 334 Pennsylvania Ave.

Scranton—Shiffman's Inc., 222 Lackawanna Ave. (3).
 Simpson—Telephone Engineering Co.
 Tarentum—Saul's Army & Sporting Goods Store, 308 5th Ave.—11.
 Upper Darby—Ram Associates Inc., 32 Glendale Rd.—11.
 Waymart—Surplus Saving Center.
 Wilkes-Barre—Duncan Sports Center, 7 E. Market St.
 York—Globe (The), 246 W. Market St.
 Ort (Karl), Box 1563, Cat., W&R, Min. 25% 1, 2, 4, 5, 7, 14, 16, 19, 23, 24, 25, 32, 34, 38, 40.
 Surplus Inc., Box 789—1, 3, 8, 25, 44.

RHODE ISLAND

Cranston—B&M Supply Co., 1010 Park Ave. (10).
 Providence—Adler's Army & Navy Store, 173 Wickenden St. (1).
 Rounds (T. W.) Co., 52 Washington St.
 Samson's Sporting Goods, Pine and Portland St. (7).
 Service Center, 84 Fountain.

SOUTH CAROLINA

Charleston—Eagle Army Store—569 King—11.
 U. S. Army Navy Store, 587 King St.—11.
 Columbia—Carolina Surplus, 1036 Washington St.
 Motor Mart (The), Inc., 6800 Devine.
 White (J. B.) & Co., 1527 Main St.
 Florence—Florence Army & Navy Store, 185 N. Dargan St.

SOUTH DAKOTA

Aberdeen—Main Surplus Store, 218 Main St.
 Gettysburg—Moore (J. E.) Hardware Co.
 Mitchell—Educator Supply Co., 309 Lawler St.
 Sioux-Falls—Lewis Co. (The), 119 N. Main St.
 Rapid City—Woodford & Woodford, 514 St. Joe St.

TENNESSEE

Chattanooga — Brainerd Army Store, 4923 Brainerd Rd.—8, 11, 28.
 Jack's Army Store, 427 Market (Jack Silverman)—11, 24.
 Reliable Loan Office, 831 Market—11.
 Ward (Roscoe) Bargain Bazaar, 3831 Hixson Pike.
 Knoxville—Camel Mfg. Co., 329 S. Central (Gene B. Laxer), Cat., W—11.

Washington

Fisher's, 106 W. Vine Ave.
Memphis—Memphis Equipment Co., 766 S. 3rd St.—39, 44.
 Midwest Jobbing Co., 134 E. Carolina (2), (D. I. Cohen, Sig Schwartz).
 Southern Parts Corp., 1268 N. 7th St. (7).
 United Road Machinery Co., 2010 S. Bellevue St.—14, 23, 44.
Nashville—Army Surplus Store, 1700 West End Ave.—11.

Southeastern Supply Co., Hydes Ferry Rd.
 Southern Army Surplus, 5128 Charlotte Ave. (9), (Bernie Geringer).
 Tennessee Steel & Supply, 710 S. 2nd St., Box 1182 (Mitchell Magid)—30.

TEXAS

Amarillo—Sadycki Salvage, 313 E. 4th.
Austin—Army Surplus Store, 615 E. 6th—11, 24, 33.
Beaumont—G.I. Surplus, Box 48, 1036 Calder (J. Dale Ramsey), W&R.
Corpus Christi—Six Points Surplus Store, 1614 S. Alameda—11.
Dallas—B & B Sales, 11444 Harry Hines Blvd. Beacon Co. (The), 4538 McKinney.
 Dallas Salvage Co., Box 1619.
 Fair Jobbing Co., 1422 Marilla.
El Paso—Commercial Sales Co., 520 W. San Antonio.
 Del Norte Trading Post, 201 S. El Paso.
Fort Worth—Gordon & Pope Supply Co., 2508 E. Lancaster.
 Salvage Hardware Co., 1817 Skyline Dr. (14).
 Warren (Dean) Government Surplus, 4105 N.E. 28th St., R—23, 44.
 Williams Tool Sales Co., 308 W. Weatherford St.—40.
Galveston—Texas Sales Co., 2401 Market.
Houston—Gulf Coast Industrial Supply Co. Inc., 5910 Long Dr.
 Industrial Machinery Supply Co., 5906 Armour—14, 16, 23, 24, 40.
 Interstate Salvage Co., 2805 Lyons St.
 Southern Trading Co., 4012 Griggs Rd., Box 14483 (21), (L. S. Davidson).
Irving—Midway Supply Co., Box 427.
Lubbock—McGehee Supply, 816 Main St.
San Antonio—Battery Salvage Co., 1915 S. Presa St.
 Hutchins Bros. Inc., 217 Alamo Plaza.
Texarkana—Boyd's Tool & Supply, 1714 W. 7th.
Waco—Salvage Sales Co., 1003 Austin.
Wichita Falls—Stern Sales Co., 500 10th St.

UTAH

Murray—Premier Surplus Center, 5140 S. State St.—11.

Ogden—B & L Surplus Sales, Box 150.
 Ogden Equipment Co., 1760 Wall Ave.
Provo—Premier Sales, 351 W. Center St.
Salt Lake City—National Dept. Store, 246 S. State St.
 Western Trading Co., 140 S. State St.—10, 11.

VERMONT

Brattleboro—Army Navy Store, 74 Main St.
Burlington—Levin's, 170 College St.
Rutland—Outlet Store, 24 Evelyn St.
 Rutland Surplus, 138 West St.
St. Johnsbury—Caplan's Army Store.

VIRGINIA

Alexandria—Alexandria Surplus Co., 2501 Duke—40.
 Kramer Equipment Co., 1621 Huntington Ave.—14, 16, 24, 40.
Falls Church—Falls Church Sales, 588 S. Washington Ave. (Leon Lassen).
Lynchburg—Army & Salvage Co., 1123 Main St.
Newport News—Army & Navy Store, 3000 Washington Ave.
Norfolk—A & N Stores, 519 Granby, R—11.
 Exchange Sales Co., 1209 E. Brambleton Ave., Box 1669 (J. Leitman)—8, 11, 15, 24, 29, 35, 40.
 M & G Sales Co. Inc., 2609 Granby—11, 24, 28.
Petersburg—Seaboard Salvage Co., 128 N. Market St.
Portsmouth—Beacon Sales Co., 205 High St.
Richmond—A & N Stores, 1315 Hull—11.
 Redmond Lumber Corp., Box 1068, 3400 Lawter Ave. (J. J. Redmond, Jr., J. J. Redmond III).
 United Surplus Stores, 208 E. Broad—11.

WASHINGTON

Bellingham—Northern Sales, 1318 Commercial St., R.
Olympia—War Surplus Trading Post, 531 W. 4th St.
Seattle—Aircraft Equipment & Salvage, 6140 4th Ave. S.—2, 17, 30, 36.
 Cook (R. L.) Sales & Supply Co., 2762 4th St. S., R—16, 24, 28, 29.
 Pacific American Commercial Co., 2911 E. Marginal Way S. (Fred A. Stewart)—40, 44.
 Puget Sound Salvage & Equipment Co., 2960 4th St. S.—24, 28, 29, 45.
 Surplus Bargain Center, 2400 1st St. S.—11, 24.
 Washington Liquidators Inc., 5628 Airport Way—15, 32.

Washington

Winters (R. S.) Co., 6169 4th St. S.—11, 24.
 Spokane—Conley Chemical Co., 4th and Ash
 Sts. (10).

General Surplus Stores, 2nd & Wall—11.

Trading Spot (The), 2516 E. Sprague—11.

Tacoma—Salvage Sales Inc., 11602 Pacific Hwy.
 S.W.

Willner (Joseph), 2309 Pacific Ave.

WEST VIRGINIA

Bluefield—Efron (A.) & Co., 120 Princeton
 Ave.

Charleston—Joe's Bargain Fair, 900 Penna.
 Ave.—11, 40.

Huntington—Crump (George C.), 1616 Wash-
 ington Ave. (4).

Parkersburg—Tri-State Tool & Supply Co., Box
 827—40.

Wheeling—Revin's (Jules) Sports Shop, 1136
 Main St.—11.

Surplus Value Center, 1133 Main St.

WISCONSIN

Appleton—Wal-Dan Trading Co., 1322 E. Wis-
 consin Ave.

Burlington—A & K Equipment Mfg. Co., Box
 389.

Master Mechanic Mfg. Co., Wilmont Ave.
 (Harry J. Allen), Cat., W & R, Min \$2.—
 4, 6, 7, 14, 23, 25, 27, 40, 45.

Fond du Lac—Fond du Lac War Surplus, 78 W.
 Scott St.,

Green Bay—Paynter Equipment Corp., 1734
 Cass St.—23.

Great Green Bay Surplus Store, 330 Main St.
 —11, 33.

Kenosha—Garb's, 5707 6th Ave.

La Crosse—Bill's Hardware & Sport Shop, 516
 Copeland Ave.—11, 24, 40.

Madison—Army Surplus Store, 422 State St.—
 11, 33.

Consolidated Rubber Co., Rt. 3, Box 183,
 Syene Rd.—5, 39.

Eastwood Army Store, 2098 Atwood Ave.—
 11.

Washington Army Store, 121 E. Washington
 Ave.—11.

Milwaukee—Buy Rite Stores, 445 N. Plankinton
 Ave.

National Supply & Hardware Co., 1235 N. 3rd
 St. (12)—24, 40.

PX (The), 727 W. Wisconsin Ave.

Tri-State Distributing Co., 744 N. 4th St.

Oshkosh—Bauer (C. F.) & Sons, 24 Washington
 St.

Racine—U. S. Surplus Stores, 339 Main St.—
 11, 33.

Sheboygan—Sheboygan Iron Metal Co., 2821 N.
 19th St.—30.

Star Sales, 1031 N. 8th St.

Wausau—Basserman Bros. Surplus, 119 Clinton
 St.

Wisconsin Rapids—Rapids Surplus Store, 631
 W. Grand Ave.

WYOMING

Casper—Mitchell Army Store, 960 N. Grant.

Cheyenne—Factor's South Side Surplus, 615 S.
 Greeley Hwy.

Wolf (Dave) Sporting Goods, 217 W. 16th St.
 —11.

Cody—War Surplus Store, 1248 Sheridan Ave.

Riverton—Surplus Mart, 709 E. Main St.

Sheridan—Northwest Enterprises Inc., 101 S.
 Main St.

CANADA

Calgary—War Surplus Store, Ltd., 137 7th Ave.
 E.

Hamilton, Ontario—Hamilton Industrial Sup-
 ply, 45 Mountain Ave.

Montreal, Que.—Allied Radio Electronics Ltd.,
 2457 DeCarrieres St. (Sam Klein)—17.

Baron (A.) & Sons, 2275 Florian St. (24),
 (Rubin Baron).

Landor Trading Co., 3900 St. Lawrence Blvd.
 Smith Sales Co., 4650 St. Lawrence Ave.
 (Gerald Smith).

Ottawa, Ont.—Globe Firearms Ltd., 140 St.
 Paul St. (Mortimer English)—21.

St. John, Newfoundland—Army & Air Force
 Surplus Sales, 149 Duckworth St. (Jerry
 W. Fried).

Toronto, Ont.—Hercules Sales Ltd., 4006 Dun-
 das St. W. (Archie Goldstein).

Levy Auto Parts Co., 1400 Weston Rd.—3.

Sportsman's Shop, 150 King St.—11.

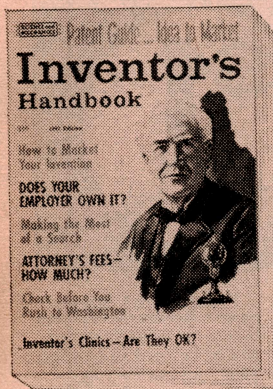
Westbourne, Man.—Westbourne Supply (J. L.
 McMaster).

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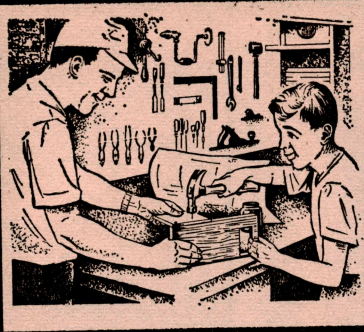
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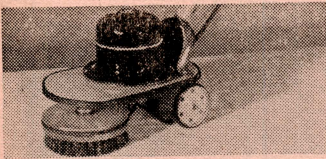


Select One of These PLANS for Your Next Project

The editors of Science and Mechanics magazine have chosen the craft prints in this catalog for their outstanding design, utility value and ease of construction. Each craftprint is fully illustrated, has step-by-step construction procedure and a complete materials list. All craftprints are unconditionally guaranteed to meet with your complete satisfaction or your money will be refunded.

HOME FURNISHINGS & EQUIPMENT

193. ELECTRIC FLOOR POLISHER. A very powerful and efficient floor polisher can be built from an old Hoover motor and other discarded materials easily available. This polisher will save you hours of hard work and will put a beautiful polish on your floors. Complete instructions are given to put the motor in good working condition and to connect it to the polishing unit. The materials list shows parts needed and where to get them. You'll find this a handy appliance to have around the house. \$2.00



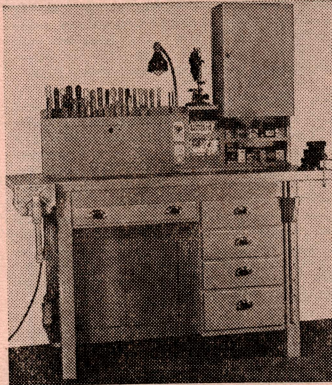
Electric Floor Polisher—No. 193—\$2.00

194. CONVERTIBLE SOFA BED. A handsome living room sofa that becomes a double bed six-footers can stretch out on comes in mighty handy for bedding down overnight guests or as a third bed in two-bedroom homes. Our plans give detailed instructions and step-by-step illustrations showing how to build this project. \$2.00



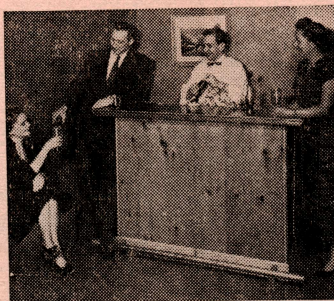
Convertible Sofa-Bed—No. 194—\$2.00

217. MULTI-PURPOSE WORKBENCH. Occupies a minimum of floor area, yet this workbench has more than 11 cu. ft. of space for storing all the hand tools you'll need, including small portable electric tools and appliances such as a drill, sander, glue pot and soldering iron. Special features are: a generous-sized linoleum-covered working surface with a shaving trough; a compartment for sandpaper and sanding blocks; 5 roomy drawers; 2 tool cabinets; file and screw-driver racks; shelves; magazine holder; built-in elec-



Multi-Purpose Workbench—No. 217—\$2.00

trical outlets complete with pilot light; overhead adjustable lamp; a supporting device for holding long work and a 20 x 22 in. drawing board. The overall working surface is 62 by 26 inches. Never before has such a versatile workbench been designed. Two large plan sheets. \$2.00



Portable Beverage Bar—No. 218—\$2.00

218. PORTABLE BEVERAGE BAR. Ideal for home or small apartment use, this beverage bar can be folded up into four lightweight pieces and stored in a clothes closet or carried in your car to a friend's house. The bar is large enough to accommodate six people comfortably and will be the center of interest at any house party. It can be constructed of knotty pine, wall-panel type plywoods, mahogany,

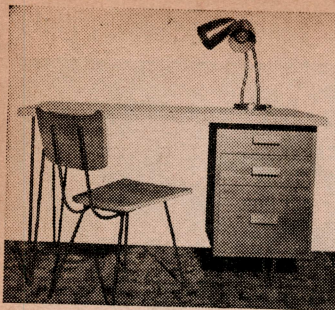
oak, grooved or sandblasted fir plywood—whichever best harmonizes with the room walls. Every step needed to explain the construction is given in detail. Build one for your next party. \$2.00

220. 3-IN-1 SAWHORSE. This is not just another sawhorse, but a veritable workshop which will save you many steps around the house because it can be easily moved from one job to another. Hand tools can be stored in the space beneath the top, while bins located between the legs hold small portable electric tools. A shelf holds a carry-all tool box which, in addition to holding handsaws, plane irons and other hand tools, has a drawer for chisels, bits, screwdrivers and an assortment of nails and screws. The generous width of the top of the sawhorse provides a wide platform for use when painting walls and ceilings. Here is a sawhorse that should be standard in every home. \$2.00

229. AUTOMATIC CLOTHES DRYER. Now you can build a 110-volt automatic clothes dryer for approximately \$80.00. It will simulate sunshine and destroy odors and bacteria. It will take about 9 lbs. of clothes and dry them in 45 minutes to 1½ hours depending upon the type and weight of clothing material. Complete instructions, bill of materials and detailed drawings show you how to build this useful home appliance. \$2.00

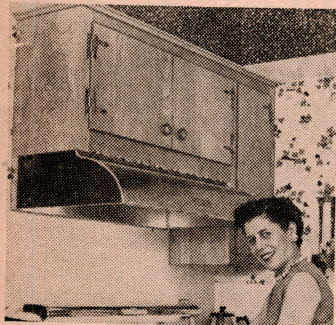


Automatic Clothes Dryer—No. 229—\$2.00



Desk and Chair—No. 231—\$2.00

231. MODERN MATCHING DESK AND CHAIR. This artistically proportioned desk and chair of modern design is sturdy functional and has a working-size top. Three drawers, one of filing-drawer size provide plenty of storage for stationery, accounts and personal receipts, bills, etc. Construction is simplified by using large panels of veneered $\frac{3}{4}$ -in. plywood which serve as both framing and covering material. Wrought iron legs and chair frame make this an interesting combination metal and woodworking project. \$2.00



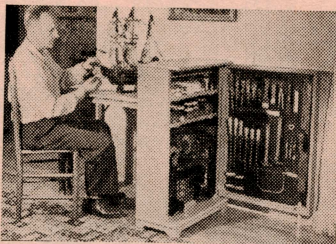
Kitchen Cabinets—No. 240—\$2.00

240. KITCHEN CABINETS. Making and installing new natural wood finish kitchen cabinets and an over-the-range hood ventilator not only increases the value of your home but also gives your family the convenience of modern living at a low cost, since you save by building the cabinets and base-cabinet fronts yourself. Five different types of wall and base or counter cabinets are used to transform and modernize the kitchen. Complete building plans for each basic cabinet are included in this kitchen modernization program. Cabinets are designed so that they may be altered to suit the particular size and shape of your kitchen. No detail is overlooked. \$2.00



Multi-Purpose Divider—No. 241—\$2.00

241. MULTI-PURPOSE ROOM DIVIDER. Although this room divider has the appearance of a built-in unit, it is completely portable and may be moved about the same as other pieces of furniture. Its basic purpose is to separate two rooms but it can be used as a buffet for party snacks, a china cabinet, knick-knack display rack and storage unit for dishes, glassware and bottle goods. Helps to make your home more livable. \$2.00



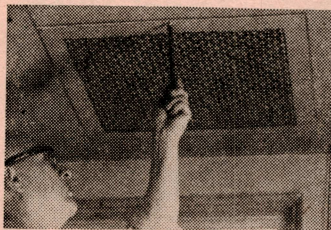
Fold-Up Work Bench—No. 244—\$2.00

244. LIVING ROOM WORKBENCH. What appears to be a piece of furniture is actually a self-contained workshop designed specifically for hobbyists living in small homes or apartments. It will accommodate a general assortment of hand and electric tools, plus containers for paints, screws, nails and model or craft parts and has a combination shaving trough and tool holder. Convenient table height. When folded up, it occupies only $11\frac{1}{2} \times 25\frac{1}{4}$ in. floor area. All construction details thoroughly explained. \$2.00

252. CONCRETE STAIRS. If you have always admired those neat concrete stairs with ornamental iron railings, here's how you can do it yourself at a big saving. You save in other ways too; the improvement will increase the resale value of your property, and concrete stairs will never rot and need replacement or painting. This plan shows how to build the concrete foundation wall, prepare and pour the concrete mix, finish the surface, and install the iron railings. Add beauty to your home. \$2.00

253. ROLL-AWAY LAWN FURNITURE. By carefully nesting all of the pieces of this project together, you can make a cocktail table, two comfortable chairs and a chaise lounge from one sheet of plywood. A full-size pattern, plus detailed instructions for cutting, assembling and finishing this project are given. All you need do is to trace the pattern and start cutting the parts. Lightweight construction makes it easy to roll the entire set away for storage. \$2.00

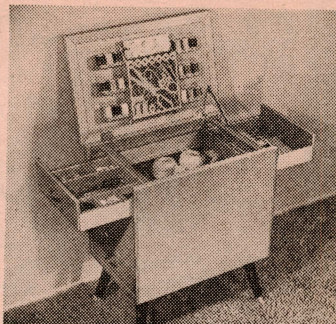
254. KITCHEN VENTILATOR. You can now easily carry away cooking odors and grease-laden fumes with a kitchen ventilator installed to your exact requirements. Whether you need a ceiling ventilator, a cabinet ventilator or a wall



Kitchen Ventilator—No. 254—\$2.00

ventilator, this plan will show you how to build it. Explains the basic needs for each type of ventilator and which one will give you the best results. Enjoy the added comforts a kitchen ventilator will give your family by installing one now. \$2.00

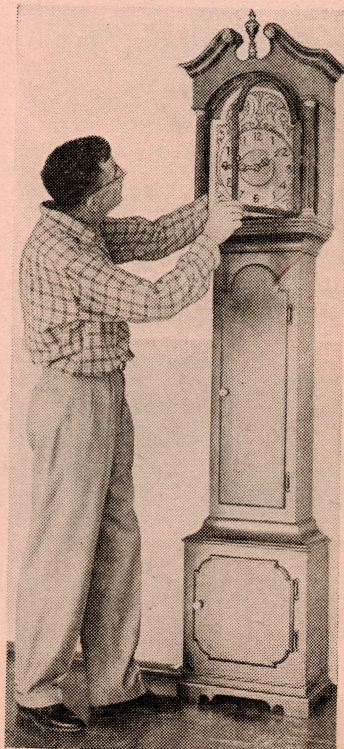
257. SEWING CABINET. At first glance this project looks more like a chairside end table than a sewing cabinet for it makes an attractive addition to any living room. Yet, it contains two half-length, tray-drawers at the top, a lid



Sewing Cabinet—No. 257—\$2.00

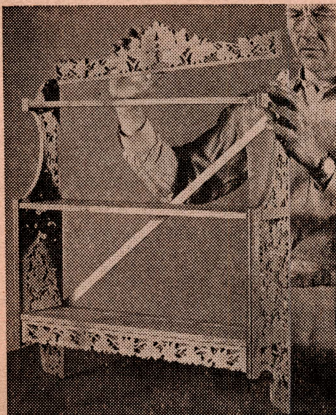
that holds spools of thread and dress patterns, a large 6-in. deep storage cabinet, and a full-length drawer at the bottom. The arrangement of the cabinet is such that you get maximum use of the space. A detailed bill of materials, step-by-step instructions, and large, clear drawings make it an easy job to build this project. The ideal surprise gift for your wife. \$2.00

262. GRANDFATHER CLOCK. The grandfather clock with its tall case and mellow chimes emerges from the lore of the past as a doubly-prized possession. If constructed by the man of the house, it never lacks as a conversation piece in his home. This beautiful clock will add charm to your home and be of practical service, too. Two large plan sheets, with detailed drawings, bill of materials, and instructions, explain every step in its construction. \$2.00



Grandfather Clock—No. 262—\$2.00

JIGSAW PROJECTS

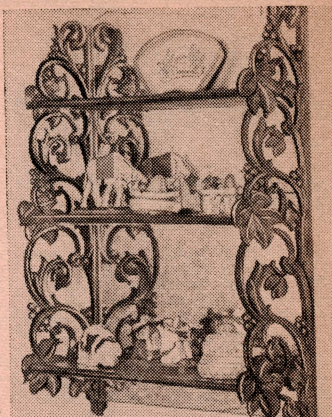


Wall Shelf—No. 26—\$2.00

26. 18th CENTURY WALL SHELF. The scrolled grape leaf pattern of this shelf blends in with the design of this wall-piece for displaying figurines, vases and chinaware. It provides a project for the woodcraft hobbyist that may well be an heirloom in the years to come. Size: 23½ in. long by 26¾ in. high and 5½ in. deep. Full-size pattern. \$2.00

90. JIGSAWED WALL SHELVES. Three full-sized patterns for making 1) a small shelf suitable for an electric clock or collector's items, 2) unique design of blond berries in relief, and 3) a lacy filigree design wall shelf that will add beauty and charm to any home. Complete instructions for making all 3 projects. \$2.00

285. MIRROR-BACKED WHAT-NOT SHELF. A prime example of the decorative effect of pierced carving, this mirror-backed what-not shelf adds a distinctive note to any room in which it is hung. Full-size patterns. \$2.00



Mirror-Back Shelf—No. 285—\$2.00

MODEL BOATS

29. MODEL MOTOR SAILER "STAR DUST." This attractive 27 in. sloop will add nautical atmosphere to any recreation room or mantelpiece. Full construction details and bills of materials. \$2.00

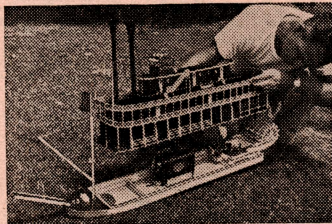
37. MODEL YACHT "SEA BREEZE." Model yacht racing is a sport every man and boy will enjoy. This trim model yacht is 36 in. long, has 487 sq. in. sail area, 42 in. mast, draws less than 6 in. of water, has deep fin keel and can be constructed of three-ply Weldwood. Designed for championship racing. \$2.00

58. COAST GUARD LIFEBOAT. The construction of a 9-3/16 in. scale model of this seagoing lady is quite simple. It will make a splendid conversation piece for your den or recreation room. Detailed drawings, list of materials and step-by-step instructions make it easy to build. Every model builder interested in the sea should build this project. \$2.00

151. ELECTRON III. Here is the very latest in scale model cabin cruisers—a model that will run rings around any single channel radio-controlled job on the water. A unique remote control system permits you to run it without any expensive radio transmitters or receivers. What's more, no FCC license is required to operate the remote control unit. You just aim a beam of light, from shore, at the rotating photocell on the model and she responds to your command. It's fantastic! It's fun! And you can build one easily from our plans and instructions. All parts are readily obtained. \$2.00

181. COAST GUARD PATROL BOAT. Model of YP class wooden hull patrol boat used in World War II along the shipping lanes along the Atlantic Coast to hunt Nazi submarines. Built to ¼ in. scale. Has forward anti-aircraft gun and dummy depth charges that operate by delayed action. You can install a small electric 6-volt motor or ½-A Class gas motor for power. Every step in construction clearly explained. Two large sheets. \$2.00

196. DIXIE BELLE RIVER BOAT. Now you can recapture a bit of Mark Twain's Americana by building an authentic 40 in. steam-powered operating model of a Mississippi Stern-Wheeler or a 20 in. shelf model. All construction details, materials list and procedure given. \$2.00



River Boat—No. 196—\$2.00

205. SEA-SLED. A streamlined airfoil-type hull enables this 14 in. racing boat to zoom over the water at a fast clip. Sea-Sled weighs only 5 oz. and, with a powerful Wasp or any .049 cu. in., gas engine, it will give hot competition to any boat on the lake. Construction is ultra-simple so you can build a Sea-Sled in one day and race it the next. Plans are full-size. \$2.00

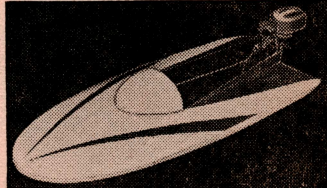
214. LITTLE SQUIRT FIREBOAT. This model is radio-controlled so that it can be maneuvered in the water by a remote transmitter. Even the water pump, which shoots a stream of real water through its gun-type nozzles, is remotely controlled. Two electric motors drive the boat at a



Fireboat—No. 214—\$2.00

fast clip as though it were in a hurry to get to a fire. Three large plan sheets explain every detail of construction. \$2.00

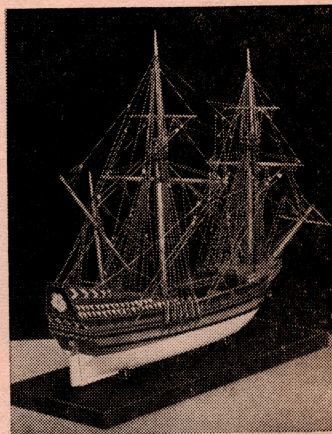
256. HASTY HORNET, JR. Weighing less than 16 ounces, this 16½-in. long, sleek model hydroplane with its battery-powered outboard motor will speed along at well over 30 scale miles per hour. It's a one-eighth scale model of our famous high-speed hydroplane "Hornet" (Craft Print 161) that has won so many races.



Model Hydroplane—No. 256—\$2.00

Full-size plans make it easy for you to build this project. If you want speed, fun and thrills at your next model show, build "Hasty Hornet, Jr." \$2.00

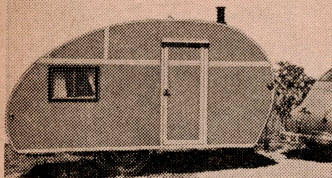
275. THE MAYFLOWER. In 1951 naval architect Wm. Baker began drawing up plans for an authentic, full-size replica of the original "Mayflower." In 1957 this replica battled its way, under full



The Mayflower—No. 275—\$2.00

sail, across the Atlantic from Plymouth, England, to Plymouth, Mass. This model, also emphasizing authenticity, is based on Baker's replica. Built to a scale of ½ in. to a ft., it is an ideal mantelpiece size. \$2.00

SPORTS & VACATION EQUIPMENT



Cabin Trailer—No. 50—\$2.00

50. CABIN TRAILER. Ideal for week-ends, fishing or vacation trips. Compact, roomy, comfortable; sleeps two people. Designed for all modern conveniences—sink, water tank and pump, stove, kitchen table, cupboard, clothes closet, drawer chest, storage space, electric lights, ventilator, etc. Sturdy, simple construction. Overall body length, 12 ft. 6 in., weight 1,100 lbs. Our master plan gives bill of materials, explains every construction detail. \$2.00



Folding Camp Trailer—No. 200—\$2.00

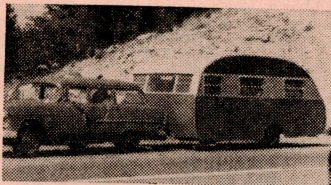
200. FOLDING CAMP TRAILER. Camping out can now be a pleasure. With "Handy Andy," you can carry your tent with you (taking about 10 minutes to set up) in a light trailer that tows easily and also carries your boat. Inside there's sleeping room for three adults or two adults and three children. You also have space for cooking in bad weather. With its 20 in. road clearance, you can haul "Andy" any place you can drive a Jeep or pick-up truck—right back to where the trout are hungriest. Two large plan sheets show you how to build this trailer. \$2.00

215. SUITCASE-SIZE POWERCYCLE. As an errand runner or for short distance commuting, this midget motorscoot would be hard to beat. Designed so that the handle bars fold down and the foot pedals fold in, this powercycle will easily fit into



Powercycle—No. 215—\$2.00

the trunk of your car. You can build this pint-size powercycle for about \$110.00. Commercial powercycles regularly sell for over \$200 to \$400 and none of them fold up the way this one does. Three large plan sheets showing all necessary parts in full size, plus the step-by-step construction details simplify the building of this project. Nicky Frances, the famous clown, has featured this powercycle on the famous Super Circus Television Show. Build one! You'll have hours of fun and enjoyment. \$2.00



Vacation Trailer—No. 238—\$2.00

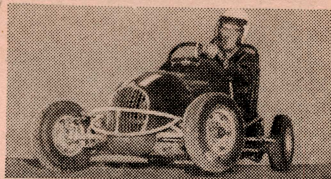
238. VACATION TRAILER. You'll save money in two ways by building your own vacation trailer. First, because you can save one-half the cost of a comparably built and equipped new factory trailer. Second, because the two largest vacation expenses, lodging and meals, for you and your family will not be much more than if you stayed at home. The plus feature of having a vacation trailer is that even summer week-ends can become short-trip, fun-packed vacation days. You'll find real comfort, too, because this trailer provides sleeping, cooking and eating accommodations for a family of five, yet it is small enough to be towed by a modest family car. Plans provide for a 14 ft., 16 ft., or 18 ft. trailer. All construction details are explained, including electrical wiring, insulating and completing the exterior and interior. Sources of supply are given for all materials and parts to simplify construction. \$2.00

247. BUILT-INS FOR TRAILERS. These project ideas will add extra pleasure and convenience to trailer life and help put valuable space to use which may otherwise be wasted. Ideas include trailer name signs for identifying the occupants of trailers and the parking lot number, cupboard retainers to keep foodstuffs from toppling over or falling off the shelves while the trailer is in transit and a utility cabinet that holds toiletries and serves as a vanity. Drawings and photos show you how to do it. \$2.00



Stutz Bearcat—No. 280—\$2.00

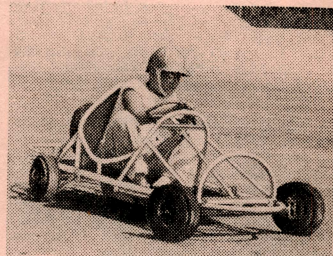
280. STUTZ BEARCAT. Your youngster will be the happiest and proudest kid in the block when he drives this gasoline-engine powered, half-scale version of the 1914 Stutz Bearcat down the street. What's more, it's a two-seater, so he'll be kept busy giving all the other kids in the neighborhood a ride. Designed with the emphasis on safety, top speed is 10 mph. (And you can reduce this maximum, if you wish; instructions are given in the plans.) Amazingly accurate in detail, the "Bearcat" requires chiefly plywood, standard lumber and standard steel stock to build. \$2.00



Micro-Midget Racer—No. 293—\$2.00

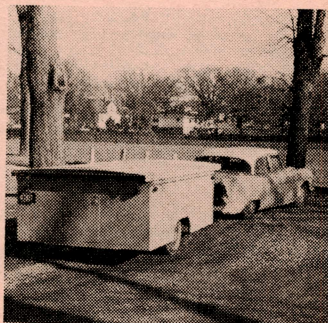
293. MICRO-MIDGET RACE CAR. Designed to meet all requirements for competition track racing sanctioned by the National Micro Midget Association, this little racer (which will hit about 55 mph. on the straightaway) is the end result of nine years of experience in building and racing micro midgets by Wayne Ison, winner of 48 feature races and two championships, and author of the official NMMA Drivers' Handbook. The cost of materials for this car is about \$400 in all, including a new engine. The same car, if you were to have it built commercially, would cost from \$800 to \$1000. Three sheets of plans explain all details of construction. \$2.00

303. PARKING LOT GO-CART. Built-in speed control and steel framework that surrounds the driver make this cart safe for youngsters 12 years old and under. Stock size electrical conduit, angle iron and bar stock are used to build this cart, and the only power tool you will need is a drill press capable of boring up to a 1/2" hole. \$2.00

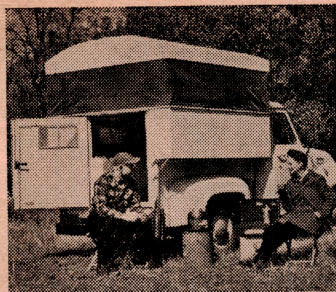


Parking Lot Go-Cart—No. 303—\$2.00

305. FOLD-UP VACATION TRAILER. Five minutes after you reach a camping site, you can have this trailer set up to provide indoor sleeping or eating accommodations for six people. When it is folded down for traveling, there is plenty of space in the trailer body to store all vacation items that otherwise clutter the car and take up usable seating space. The design has been carefully worked out in sub-assemblies so the amateur builder can use his garage or carport to assemble the parts out of the weather. You will save several hundred dollars by building this yourself. \$2.00



Fold-Up Vacation Trailer—No. 305—\$2.00



Pick-up Truck Camper—No. 309—\$2.00

309. CAMPER FOR PICK-UP TRUCK. Built with a roof that can be quickly raised and lowered, this pickup camper will give you the stand-up headroom of a large heavy camper, yet it still retains the driving advantages of the small camper which folds down for traveling. Lightweight and of sturdy construction. The collapsible roof feature reduces gas-wasting wind resistance, and sway bracing isn't needed for cornering or bucking a strong wind. Build it yourself for \$100, a savings of \$500 over a similar factory-built job. \$2.00

314. CAR TOP CAMPER. The increasing popularity of station wagon camping has caused it to become more and more a family affair, demanding additional space for sleeping and carrying extra equipment. The quick-fold car top camper solves these problems with one compact unit that can



Car Top Camper—No. 314—\$2.00

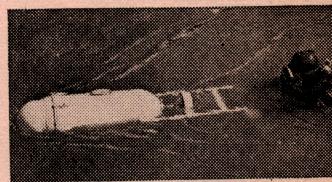
be attached to or taken off your station wagon in minutes. Mosquito-proof full-length sleeping shelter for economical touring. Fits station wagons and sedans too! Cost of the camper with ready-made shelter is about \$128, and you can save an additional \$20 by making the shelter at home. \$2.00

318. ISON RACING KART. Designed strictly as an all-out racing machine, this "roadster" style kart is suitable for A, B or C class racing. It boasts such features as live axle rear end, racing brakes, and light overall weight with forward weight distribution for high performance in competition. With twin Mc-6 engines its performance is impressive — with two of the new Mc-20 engines, it should be a track-eater of the first order. \$2.00



Ison Racing Kart—No. 318—\$2.00

320. SCUBA SCOOTER. Water is 800 times as dense as air—this you realize as you kick your way through it in your diving outfit, using up your air supply in the effort of swimming. All this hard work is done for you by the Scuba Scooter which you can build for \$175 or less. The unit can be weighted for $\frac{3}{4}$ or 1 pound positive buoyancy underwater, so that if let go, it will slowly rise to the surface. Control is automatic; if you grasp the handle at the switch, the motor turns; if you release it, the motor stops. \$2.00



Scuba Scooter—No. 320—\$2.00

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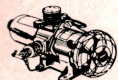
(Refer to article in this issue of Surplus Projects.) DC MOTOR. Mfg. Globe Indust. 27.5V DC @ .6A. 1/100 HP. 15,000 RPM. \$5.25 Postpaid
50uA METER. 2" face. Ideal or equal. \$6.95 Postpaid

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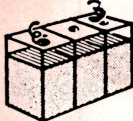


PORTABLE AIR COMPRESSOR



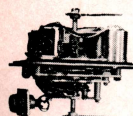
High-output 3-stage compressor charges up to 1500 P.S.I. Driven by 27-V DC. 20-amp. motor. Easily converted with 1/2-H.P. motor to belt drive. Measures 12 3/4" x 10 1/2", extremely light weight. Mfr.: Cornelius. \$37.50

NT-6 WILLARD 6-VOLT STORAGE BATTERY



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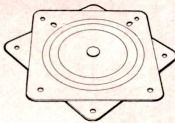


MINOR SWITCH

10-position, 3-pole with stopper coil and reset coil 6-12 volts D.C. off-normal non-bridging wiper approx. dimensions: 4" long x 4 3/4" high x 1 5/8" wide. Weight: 1 lb. \$9.95

LAZY SUSAN BEARINGS

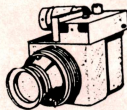
5" square, bearing race 3 1/2", (Refer to article in this issue of Surplus Projects. "10 Uses for Lazy Susan Bearings.") \$1.25 Postpaid



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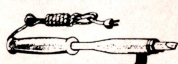
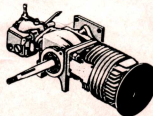


K-20

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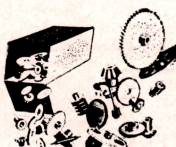


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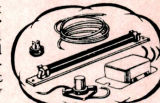
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